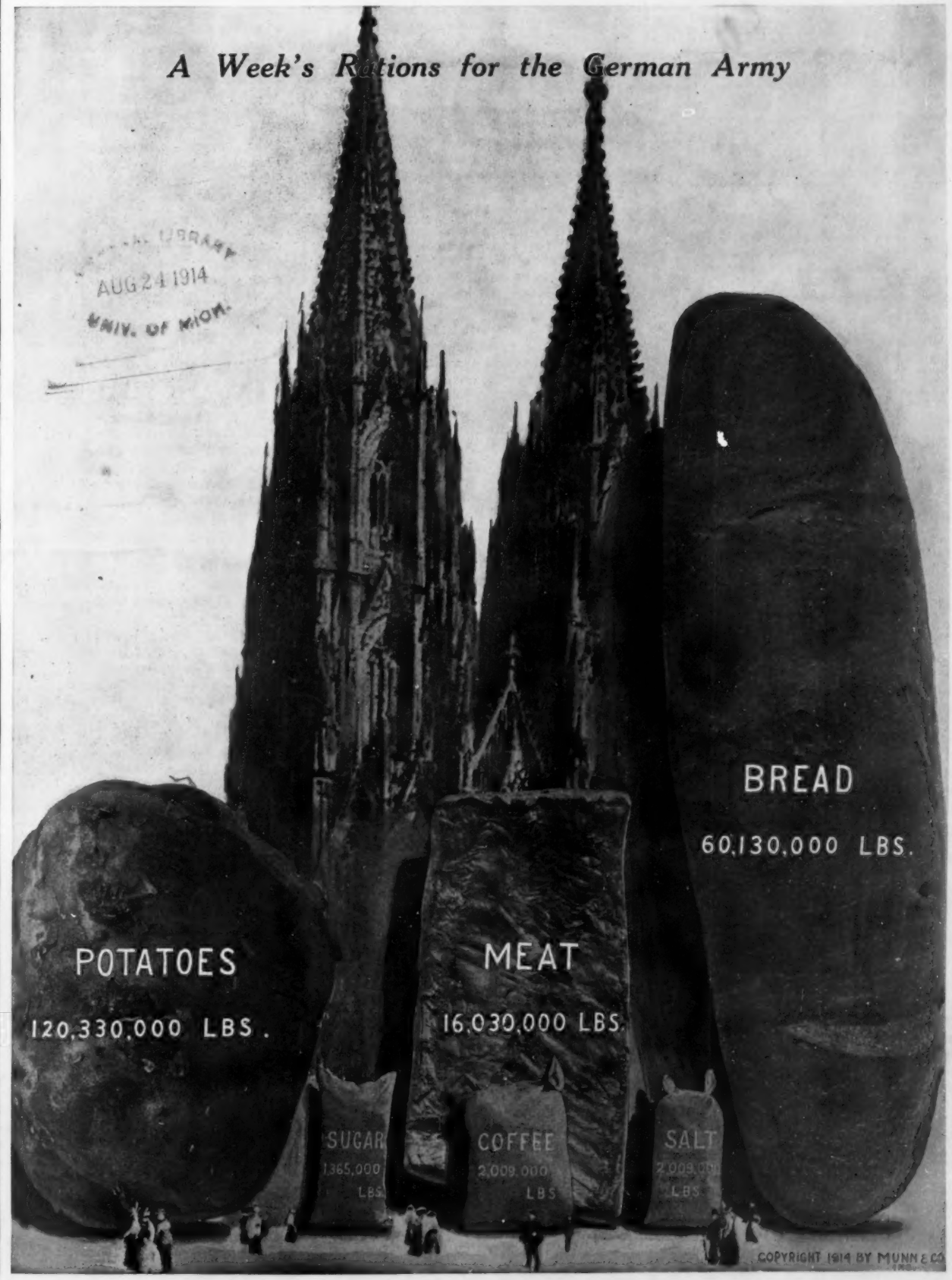
SCIENTIFIC AMERICAN



Vol. CXI. No. 8
August 22, 1914

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year

SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, AUGUST 22, 1914

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary
Orson D. Munn, Treasurer
all at 361 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter
Trade Mark Registered in the United States Patent Office

Subscription Rates

Subscription one year $5.00
Postage prepaid in United States and possessions. Mexico, Cuba, and Panama
Subscriptions for Foreign Countries, one year, postage prepaid, 4.50
Subscriptions for Canada, one year, postage prepaid 5.75

The Scientific American Publications

Scientific American (established 1845) ..... per year, $5.00
Scientific American Supplement established 1876. " " 5.00
American Homes and Gardens ..... " " 3.00
The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application
Remit by postal or express money order, bank draft or check

Munn & Co., Inc., 361 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

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The Indomitable Engineer

THE fascinating side of civil engineering lies in the mastery of unexpected difficulties. Practically every task presents its emergencies that call for ingenuity on the part of the man in charge; and it is these problems that relieve the drudgery of infinite detail and inspire the engineer with the joys of conquest. Instances of resourcefulness are to be found all around us, if only we take the trouble to look for them, particularly in New York, the city of great enterprises.

The enormous arch bridge now building across the East River at Hell Gate furnishes us with a good illustration of a unique problem and a unique solution. Work on the great viaduct that is to provide direct rail connection between New England and the South has progressed far enough to give us some conception of its finished appearance. The gaunt concrete legs of the viaduct are already a conspicuous landmark. One of the towers of the great bridge has been carried to the point where it must wait until the steel work is erected. This enormous steel arch, the largest in the world, will have a span of 1,017 feet. Were it built in the heart of New York city, we should find that it would stretch over four city blocks between towers, and the top of the arch would rise nearly as high as the Flatiron Building. The trusses, measuring 140 feet at the towers and tapering to 40 feet at the crown of the arch, will be built up of enormous members, some of them weighing twice as much as the heaviest members in any bridge heretofore constructed. Near the tower the bottom chords will have a section roughly of 7 by 10½ feet. Were it not for webs and braces, it would be possible to drive a load of hay through them. As may be imagined, the thrust of such an enormous steel arch will be something unprecedented. Each truss will exert a pressure of 30,000,000 pounds upon the foundations at the skew-back.

Here are conditions never before met with in bridge construction, but as if this in itself were not enough, a serious problem was encountered in the foundation of the tower on the Ward's Island side. Hell Gate, long a menace to navigation and still a difficult channel to negotiate, owing to conflicting tides, was known to be underlain with rock that is uptilted in a manner that might prove troublesome. Furthermore, the gas tunnel running across the river to Astoria had encountered a deep fissure in the rock, with a trend in the general direction of the proposed bridge foundation. Fearing that this fault might be encountered, extensive borings were made, but no break in the bed rock was disclosed. As the rock lay at a considerable depth and was very irregular in profile, it was deemed expedient to sink the foundation in separate caissons, using two rows of rectangular caissons, keyed together, to take the direct thrust of the trusses, with rows of cylindrical caissons between and on either side of the rectangular ones, connecting all at the top by a huge slab of concrete. Much to the consternation of the engineer, however, one of the cylindrical caissons failed to touch rock, even when carried far below the estimated depth, showing that the fissure did extend into the foundation site, after all. As the other caissons were carried down, it soon became evident that the cleft in the rock extended diagonally across the foundation. This provided a very puzzling problem. Any weakening of the foundation for such a record-breaking arch would be dangerous. If only the foundation site had been chosen a few feet to one side or the other, the fault could have been avoided; but a change in the line at this time could not be considered.

However, the solution of the difficulty was as simple as the problem seemed insurmountable. The resourceful engineer failed to see why he should not bridge the underground chasm, as he would one at the surface. Accordingly, he boldly threw a concrete arch across the fissure where it passed through the center of one of his rectangular caissons, and at another point where it cut across at the joint between two of the caissons, he bridged the gap by means of a concrete cantilever. The cylindrical caissons that encountered the fissure were carried to a considerable depth and flared to give them a broad footing.

The idea of building concrete bridges in a caisson is something absolutely novel in bridge engineering. Fortunately, the material covering the rock was clay, and hence it was not necessary to take such great precautions against the entrance of water. Otherwise the construction might have been far more difficult. The foundation has now been carried successfully to completion and forms a monument to the resource and indomitable ingenuity of the engineer.

Best Light for the Eyes

SOME three years ago the American Medical Association appointed a special committee to make a study of the effect of different lighting systems on the eye. The problem of lighting, as treated by engineers, has been for the most part an attempt to discover the most efficient forms of lighting from the point of view of economy—that is, how to get the most illumination for the least expenditure of energy. The problem of this committee has been to discover the form, distribution, intensity, and quality of light from the point of view of the health of human eyes.

The work of this committee is not yet completed, but preliminary announcements of results are of considerable interest. Among the aspects of lighting that have definite relations to the eye are: (1) evenness of illumination; (2) the angle at which the light falls on the object viewed; (3) the diffuseness of the light; (4) the evenness of surface brightness; (5) the intensity of the illumination; and (6) the quality of the light. The first four of these factors have been found by means of experimentation to be closely connected, although not absolutely uniform in their variation. Together they constitute what the experts call the *distribution* of the light. The ideal condition of distribution is to have the illumination as uniform as possible over the field of vision, with no extremes of surface brightness.

Daylight has been found to be the most satisfactory form of illumination, from the point of view of distribution. Daylight is pretty well diffused by numerous reflections before it reaches the windows. Inside the room, the window or skylight has a comparatively large area of relatively low brilliancy. These two factors contribute to a nearly uniform illumination of diffused light, with absence of extreme surface brightness.

Of the systems of artificial illumination, the so-called indirect is the best. In this system, the source of light is concealed from the eyes, the light being reflected to the ceilings or walls, and from these to the working surface. In direct illumination there is always the danger of having extremely bright spots in the illuminated surface. A system called the "semi-indirect" was found to be little better for the eye than the direct system. In this the light is thrown to the ceiling or walls, as in the indirect system; but part of the light is allowed to come through translucent shades.

The relation of the different systems of lighting to the diminishing efficiency of the eyes was brought out in a series of experiments in which daylight was shown to be almost without effect upon the eyes after three or four hours of work; under direct artificial illumination the eye loses working power at a very rapid rate, and almost as rapidly with the semi-indirect illumination. The indirect illumination was found nearly as harmless as the daylight. Sharpness of vision was also found to be highest, for any given degree of illumination, under daylight, and poorest under direct artificial lighting.

The deteriorating effect of the light upon the efficiency of the eye seems to be due to the fatigue of the muscles, rather than to any action upon the retina. Both the muscles of accommodation and of fixation seem to be affected. The explanation of the fatiguing effect of direct illumination is given by Dr. C. E. Ferree as follows:

1. The images of the bright spots near the margin of the retina arouse a reflex tendency to fixate on them instead of on the objects held in the center of attention; 2, the bright spots in the field of vision, but not in focus, arouse an unconscious reflex tendency to focus on them, so that there is constant variation in the accommodation of the eyes; 3, the bright spots fall on portions of the retina that are not adapted to them, cause discomfort and lead to spasmodic contractions of the muscles, which disturb the clearness of the image and add greatly to the fatigue. The result of these factors working together is excessive eye strain, which shows itself in a loss of power to do work.

This explains why work in daylight, under proper distribution of windows, and with sufficient intensity of illumination, is not so tiring as artificial illumination.

Of course this is not the only element that concerns the health of the eyes. The intensity and the quality of the light are also of great importance.

For daylight and the indirect system, a wide range of illumination allows the eye to continue at work for several hours without undue strain, or rather without considerable falling off in efficiency. But with the semi-indirect and the direct system, there is evidence of fatigue at every intensity of illumination. In the semi-indirect, however, the eye can continue at work comfortably at an illumination represented by something more than two candle-power at the distance of a foot from the working surface. When the intensity is considerably more or less than this, even the semi-indirect illumination soon tires the eye. As most artificial lighting systems give a much greater intensity than this, the semi-indirect systems are as injurious to the eyes as the direct systems.

However, the safe intensity of illumination for the semi-indirect system is far too low for clear vision in most kinds of work. It is, therefore, impossible to get high acuity and low loss of efficiency with any system of artificial lighting except the indirect, although the semi-indirect will suffice at the safe intensity for most home work and office work.

Can Ultra-violet Light Produce New Species?

THAT ultra-violet light is able to produce new species of microbes is the startling announcement made by Mme. Victor Henri, whose work together with M. Henri in this field is already well known, having been carried out at the Paris University laboratories. Like all specimens, microbes are divided into well-defined, recognizable species, and it was observed that such species reproduced in like fashion to produce similar specimens, with the exception of some slight variations such as give rise to attenuated types, these latter being used for vaccination. But here we have no longer to do with a simple variation, but with a veritable mutation, that is, the formation of a new species which does not return to the ancestral type. The author operates upon bacteria which produce the disease common to animals, known as *charbon*, and according to a paper read before the Academy of Sciences, she exposes the bacteria for a certain length of time to the mitigated action of a quartz mercury vapor lamp which furnishes the ultra-violet rays. Under these conditions, the microbes are not all killed, as they would be by strong rays, but all are observed to be affected by the rays. Among the new types which are formed in this way by the action of the light, there is one, termed the *gamma* form, which is seen to be especially stable. For three months the daily cultivation upon gelatine always produces the same type, and it is concluded that this is really a new species.

Searchlights for Aeronauts

GERMANY will no doubt possess a very extensive system of high power signal lights for aeronautic use, and already there are some large-sized searchlights mounted in various places. We mentioned the electric searchlight at the Weimar aviation grounds, of which each flash gives 27,000,000 candle-power. For the use of aviators at a great height there is provided a large light on the top of the Taunus Mountain, at an altitude of 3,000 feet. At present, incandescent lamps give some 500,000 candle-power, but it is intended to use arc light so as to increase this to 50,000,000 candle-power. The revolving light on the top of the wireless mast at the Neustadt station gives four-minute flashes of 300,000 candle-power, using an arc lamp for the purpose. We also note the Berncastel revolving flash, which has 150,000 candle-power. On the Doeberitz military aviation grounds is an acetylene light of 27,000 candle-power, which gives three-minute flashes, while at Kaditz, near Dresden, there is installed an eclipse lamp of 250,000 candle-power, in order to show landing places for aircraft. It gives two flashes in nine seconds. Illuminated numbers of large size are coming into use to show the aircraft headquarters to pilots, and among these is the Johannisthal grounds, which has a number lighted by lamps to the amount of 30,000 candle-power. But larger ones of 85,000 candle-power are mounted at Bonn and at Winiary. Other high power lights are installed at Königsberg, Metz, Strasburg, and Tegel, and signal lights on the Nauen and Belgerin on the wireless telegraph masts.

Engineering

Fitting Out Basin of Nagasaki.—Among the many improvements being made at the Mitsu Bishi Dockyard and Engine Works, at Nagasaki, is dredging out an immense basin to a depth of thirty feet to care for the largest ships while fitting out and increasing the size of its drydock. The length of the dock will be 784 feet and its width 115 feet, which will care for the largest battleship now building.

Irrigation in New South Wales.—The New South Wales Government is investigating an irrigation scheme which will back up the waters of the Clarence and Mitchell rivers for a distance of 80 miles. Being close to the junction of the two rivers and having precipitous hills on both sides, the site for the dam at Gorge is considered ideal. Part of the plan is to give Grafton, 40 miles below, a supplementary water supply. Ample water is looked for, for all purposes, the Clarence being regarded as the finest river in Australia. The work will cost several million dollars.

Kaiser Wilhelm Canal Locks the Largest.—The original Kaiser Wilhelm Canal was begun only 27 years ago and was finished 19 years ago; nevertheless, although it was supposed to have been built large enough to accommodate the ships of the future for a long period of years, it was soon found that it must be greatly enlarged to keep pace with the increase in the size of the ships, particularly those of the navy. The locks of the old canal were 145 meters long, 23 meters broad and 9 meters deep; the new locks are 330 meters long, 45 meters broad, and 14 meters deep. They will have a water content of 207,900 cubic meters, against a content of 124,511 cubic meters for the Panama locks. The latter are 308 meters in length.

Rail Anti-Creepers.—One of the most troublesome difficulties experienced in the maintenance of railway tracks is the tendency of the rails to creep in one direction. Creeping is due to wave action induced in the rail by the passage of the heavily loaded wheels. It is much worse on tracks in which the travel is all in one direction, the creep of course being in the direction of the traffic. Much attention is being directed to-day to the arresting of this movement, and several forms of very efficient anti-creepers are upon the market. They consist, usually, of an inexpensive form of clip with end jaws which engage the base of the rail, the clips projecting below the base and fetching up against the adjoining ties, thereby locking the rail to the roadbed against any longitudinal movement.

Wireless Station in the Society Islands.—It is hoped that the war will not interfere with the erection of that most important wireless station at Papatee in the Society Islands, work on which was to have been started forthwith by an arrangement between the French Government, its colony, and a French company. The station was to have cost about $200,000 and to have been powerful enough to communicate with New Caledonia, and perhaps with the United States. The station was a part of the work of making Papatee a port of call, in connection with which was the construction of lighthouses on five of the islands; widening, deepening and buoying the pass; repairing and enlarging the existing quays; building a new slip and providing the necessary working plant, tools, etc.

Opening of the Cape Cod Canal.—The opening of the Cape Cod Canal enables all vessels as far south as Charleston, S. C., to save 70 miles of distance going to and from Boston. Translated into other terms, this means that the average delay per round trip yearly for barges and schooners on the outside route is nearly four days, which is equivalent to a pecuniary loss of 10 cents per ton on the 7,000,000 tons of coal, and on the large amount of lumber carried by these craft. The total amount of coal and lumber carried by steamers is 4,500,000 tons annually, and the same amount per ton will be saved by these boats in using the canal. The tolls range from $3.00, for motorboats and other small craft, to $700 for trading vessels of 950 to 999 gross tons. Merchant ships of over 1,000 gross tons will pay 10 cents per gross ton for each passage.

Foreign Profits on the Sea.—Our contemporary, the *Marine Journal*, draws attention to the fact that a dividend of 10 per cent has been declared by the Nippon Yusen Kaisha (Japan Mail Steamship Company), which owns 85 steamships of 368,000 tons; all of which are employed in the sea commerce of the empire. The company is generously subsidized by the government, and the service is efficient and successful. Attention is also drawn to the fact that the amount of subsidies to steamship companies paid by the various maritime governments is steadily increasing, until it has now reached about $50,000,000 a year. Contemporaneously with this declaration of large dividends by the Japanese steamship line, the firm of John Brown & Co., ship-builders of Great Britain, has declared a dividend of 10 per cent, as compared with 7½ per cent for each of the five years preceding. What are we going to do for our languishing merchant marine in this country?

Aeronautics

Folding Aeroplane Wings.—In a patent, No. 1,104,347, for the invention of Horace Corbin, of Cleveland, Ohio, the wings are allowed to swing upward upon the operation of a simple mechanical release so that in case of accident the plane will readily and easily alight on the ground.

An Automatically Adjustable Plane.—In a patent, No. 1,102,790, George L. Oliver of La Grand, Ore., seeks to secure an automatic adjustment in a flying machine of the plane in accordance with the weight of the machine so the plane will be disposed in line with the center of gravity.

New Types of Arched Planes.—Joseph Bonnot, Alfred Belot, Jean Vassallo and Rose Emery, of Marseilles, France, have secured patent No. 1,104,242, for an aeroplane whose bearing surfaces are composed of arched planes, in which the greatest force of resistance is presented in front.

Pegoud's Latest Performances.—Our Paris aeronautic correspondent, Mr. John Jay Ide, informs us that on July 5th he went out to Buc to see Pegoud give the programme which he will present on his forthcoming tour in America. Pegoud's "dead leaf" upside down descent was thrilling, "but," says Mr. Ide, "the climax was reached when he got out of his seat and stood first on one wing and then on the other, holding on to the 'cabane' with one hand and waving to the crowd with the other, while the machine kept on an unduiating course. He did this repeatedly, causing tremendous excitement. And the Bleriot was not provided with a Sperry stabilizer."

Vertical Air Currents and Aviation.—In a recent letter to *Nature*, some interesting experiences of M. McLean are described. During his flight up the Nile, he found that the vertical air currents were frequently very marked. When the wind was only slightly different in direction from the line of the river there was a down current on the side from which the wind came, and an up current on the other side. When, however, the river split up into several channels the air was generally descending over the whole neighborhood and was disturbed. These down currents were, at times, so strong that his aeroplane when climbing at its greatest speed would descend steadily at 3 feet per second. He estimates that the maximum rate of climbing of his machine in still air was 4 feet per second. This observation is of great interest, as showing that a down current may exist of about the velocity of 4.8 miles per hour.

Carrier Pigeons on Aeroplane.—Carrier pigeons were let loose from an aeroplane at Buc not long since, and it was found that this could be done with very good success. The society, known as Colombophile Federation, wished to make trials of what could be done with pigeons when set loose at high altitudes, for it expected to be called upon to furnish pigeons for aeroplanes and airships. Trials were accordingly made in connection with the Bleriot establishment at Buc. A basket with the pigeons was stowed in a passenger's place on board a tandem Bleriot, and when at 4,500 feet altitude the pilot set the machine to volplane slightly and opened the basket, whereupon the pigeons flew out at once and took the direction of home, which lay at Agen. They were freed about 10 o'clock, and at 6 o'clock the first two pigeons arrived at Agen, after making the trip in 8 hours. It was considered that the trial succeeded very well, and further ones will be made before long.

Resistance of Struts.—It has been found possible, at the National Physical Laboratory, to reduce the travel of the center of pressure on the wings, which is the cause of all instability, to a material extent, and the interesting announcement, in the annual report of the laboratory, is made that in the near future it will in all likelihood be possible to maintain the center of pressure perfectly stationary by slightly uplifting the trailing edge in a reverse curve. The expedient has often been suggested before; to some extent it is even already incorporated in various types of aeroplanes, such as the Handley-Page and several German machines, but its effectiveness has hitherto been purely conjectural. The interplane struts on a biplane primarily, of course, are intended to form an integral part of the structure, serving simply to connect the two superposed planes. But they can also be made to serve a subsidiary function, for their collective side area may be employed to act as a fin, which usually consists of a vertical surface placed somewhere in the region of the tail, and forms an important element of lateral stability. Efficiency requires that the head resistance of these struts shall be diminished to the lowest possible point, and for this reason their shape approaches as nearly as possible to a perfect stream-line, as determined by laboratory experiments. To what a low point their resistance may be reduced will be evident from the fact that in a well-designed biplane it should not exceed 15 pounds and may well be even less. From the point of view of head resistance, the fineness ratio—that is, the relation of the length to the breadth—of a strut should be in the region of three; but if the struts are also designed to act as fins, the fineness ratio should not be less than 5 to 1.

Automobile

Carbon in the Modern Motor.—Recently some tests of the carbonaceous deposit which invariably collects after a time in all internal combustion motors, revealed that a considerable portion of the material was carbon, as was to be expected. Much of the deposit was composed of silicon and iron oxide. The presence of the silicon is ascribed to the road dust inhaled by the motor, and the rust to the water in the air and to detrition.

Germany's Motor Population.—According to official statistics, Germany now has 60,876 motorcars, 22,457 motorcycles, 9,739 motor wagons of commercial type, and 100 motorcycle carts. The latter are motorcycles with goods transportation bodies. These figures are for January 1st, 1914. The increases since January 1st, 1913, are, respectively: 21,116, 2,132 and 2,035 for the first three classifications; motorcycle carts, so called, decreased by 23.

Car Orders as Prizes.—During the latter part of August, an endurance contest will be held in Russia by the Grand Army of the Empire. It is to be known as the Coupe de l'Empereur and is offered for the purpose of ascertaining the type of motor car most suitable for use under Russian road conditions. The first prize will be an order for 250 cars, the second an order for 150 cars, the third an order for 100 cars, and the fourth an order for 50 cars.

Lubrication of Leaf Springs.—That the ordinary type of leaf motor car springs requires lubrication between the leaves at length appears to have been appreciated. Already a number of devices calculated to provide the lubrication have been placed upon the market. The latest device of the kind consists of a tiny metallic box which clamps to the outside of the leaves and which serves as a receptacle for oil.

An Electric Lighting Fault.—Electric lighting systems as a general rule have the fairly common fault that they project the light in two pencil-like beams which move with practically every motion of the car body; in other words, the diffusion is not great enough. What is desired is not so much great projection as more uniform diffusion which will more nearly approximate daylight. Another difficulty of the pencil-like projection is that it tends to magnify the size of small humps and bumps in the road. It would seem that some modification of the usual form of parabolic reflector is desirable.

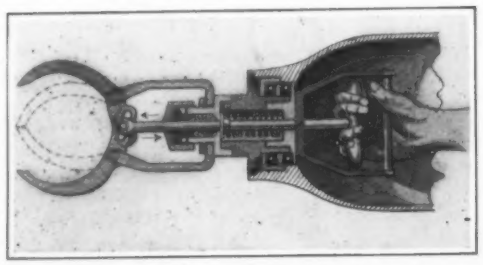
A New Application of the Maxim Silencer.—A correspondent suggests that some one might devise a closet tank silencer fashioned after or following the principles availed of in the Maxim silencer for firearms. While automobile engines have been employed for various purposes entirely apart from the propulsion of the car, he does not recall any attempt to utilize the automobile engine in raising or lowering the top of the car. We hear of one man tops and other improvements, and it seems that in some way the engine might be adapted to furnish the power for adjusting the top.

Are Motor Car Hoods Necessary?—Now that the magneto has been made waterproof, and other parts of the modern motor car engine are so thoroughly protected from dirt and moisture, the question naturally arises, "Are engine hoods really necessary?" Why is it not possible to produce an engine so thoroughly enclosed that the ordinary sheet iron covering can be dispensed with? This should not be difficult, for already the valve mechanism is hidden behind metal plates; also, in a number of cases, the carbureter is all but enclosed. It should not be difficult to provide a carbureter intake which will permit of sufficient inspiration yet exclude such foreign matter as dirt and water.

Motor Testing by Vision.—There has been placed upon the market a new type of internal-combustion-engine testing device which makes use of a number of Geissler tubes. The tubes are contained in a small light-proof box, each being connected to one of the spark plugs of the motor. The discharge from the magneto, being high-tension current, causes the tubes to glow. The intensity of the glow will be affected by the condition of the magneto, and the degree of compression in the cylinders, which governs to a certain extent the ease with which the sparks will pass the spark gaps at the plugs. The failure of one tube to glow, obviously indicates that there is trouble in the corresponding spark plug, or magneto lead.

The Ideal Motor Car.—The question, "What is the ideal motor car?" is a moot one, and for this reason the discussion which revolved about it at the annual meeting of the Society of Automobile Engineers is enlightening. As a result of several sessions, it evolved that the ideal car in the opinion of the majority incorporates the following features: High-speed, high-efficiency motor with six cylinders measuring about 3 by 5 inches bore and stroke, respectively; streamline body; weight about 2,750 pounds with full equipment; electric lighting and engine starting system; dry plate clutch; four-speed gear set; worm drive; full-floating rear axle; cantilever springs; left side drive with center control; magneto ignition; pump circulated water cooling; double internal expanding brakes.

The diver getting into the suit.



The twelve-fingered steel hand manipulated by the diver. It will pick a pin from the floor.

An All Metal Diving Suit

It Carries a Man Safely to Greater Depths Than Have Hitherto Been Attained by Divers

By Robert G. Skerrett

Attaching the arms to the suit.

DESPITE all the manifest dangers of diving, men have gone down to great depths and have performed labor there. In some cases the descents have carried them to submergences of from 160 to 180 feet, but their serviceable stays there have been very brief—a matter of a few minutes only at a time, and, in most of these instances, the underwater toiler has paid the price of his battle with nature's laws by sacrificing his health or materially shortening his days. The lure of treasure has inspired the venturings, and the price paid for the service seemed for the time to compensate.

The average diver seldom works in water more than 100 feet deep, and there are but few experienced men that can be counted upon to do good work at a depth of 150 feet. It is because of these human limitations that so many richly-laden wrecks lie undisturbed just beyond the reach of these toilers in the deep. Unquestionably, there are millions of dollars' worth of treasure trove awaiting recovery, and the tantalizing part of it all is that these richly burdened hulks are well known and reasonably well located.

The situation has been potentially altered here very recently by the experimental testing of a new form of diving dress, or armor. This all-metal dress was tried out in Long Island Sound, and twice in one afternoon, with the tide running strong, two divers were alternately sent to the bottom at a depth of 212 feet. Unquestionably this constitutes a world's record; but the performances were otherwise of the utmost practical significance. Let us give you material for comparison.

Several years ago, after a number of distressing accidents, the British Admiralty determined to make some scientific tests in the hope of eliminating certain dangers to which the naval divers were exposed in service. Without going into details, but by using double the number of air pumps and adopting several important precautionary measures, they did succeed in sending down two unusually fit men to a depth of 210 feet in the sheltered water of a land-locked bay. Now keep the next fact in mind. In descending, bottom was reached in two minutes, and, after a stay of 5¾ minutes, the men were slowly brought back to the surface—the *ascent taking 50 minutes!* This was required to insure safe decompression and to guard them against any ill effects of their great submergence.

In the all-metal armor tested in Long Island Sound a couple of weeks ago, the men were lowered to the water-bed in a trifle over 3 minutes, being held when about a hundred feet down to see that the telephone was working properly. After being on the bottom for ten or more minutes, the divers were hoisted up and out upon the deck of the parent steamer in less than a minute and a half. Why was it possible to do this in the latter case and not with the British Admiralty divers? Simply because the American divers were not subjected to the hydrostatic pressure of the enveloping water, and were able to breathe air at atmospheric pressure. Their bodies were not subjected to abnormal stresses, and, therefore, no period of readjustment was necessary.

More than that, the air supplied then was abundant, their respiratory organs worked as they would at the sea's surface, and the ventilation of the suit was ample enough to carry off their exhalation and to prevent the accumulation of deleterious carbonic acid gas—the cause of so many accidents to divers in the ordinary dress. Again, working at the accustomed atmospheric pressure, there was not an excessive exhalation of carbon dioxide, nor none of the weakening conditions peculiar to labor in compressed air. Therefore, it would be possible for a diver in this new armor to work longer, to work harder, and accordingly to do more because of his physical security in the metal dress.

In the language of real estate agents, the suit is supplied with all modern conveniences.

Hoisting the diver out.

Briefly, this particular innovation in the art of subaqueous enterprise is the result of some years of gradual evolution, and is the invention of Chester E. Macduffee of New York city. The suit is made of an aluminium alloy of great strength, and even so weighs a matter of quite 480 pounds. The articulated sections are clever adaptations of the sleeve or rotating joint, and while suitably packed to reduce leakage to a reasonable minimum, still, thanks to roller bearings, give the diver ample freedom of action when the weight of the dress is taken up by the surrounding water. Indeed, a certain amount of leakage is desired, for it serves to lubricate the moving parts and, too, to keep the packing swelled, and, therefore, more efficient. But how is this leakage disposed of? This is one of the most admirable features of the armor.

In a recess back of the main body or trunk of the suit is installed a powerful little pump with suction intakes located in each foot of the dress. The discharge is immediately outboard and, of course, against the water head. The pump is driven by compressed air, this exhaust is delivered into the suit, and thus meets the breathing needs of the diver. The air is led down through a small tube, together with the electric light and telephone circuits, which, in turn, are carried in a 2½-inch armored rubber hose. The free space remaining in this big tube forms the channel back to the surface of the used air. The diver has no life-line to bother with, and his telephone permits him to keep in constant communication with his surface attendants. Should the telephone fail, the diver would be at once hauled up, but when working it makes it impossible to misunderstand signals or the submerged man's needs.

As a matter of contrast with the ordinary dress. When the second diver descended, he was held for some minutes at a depth of 100 feet. At that time the air compressor stopped, and it was not noticed by those in charge of him. Nevertheless, he hung there placidly unconscious of the breakdown, and was lowered to the bottom after the engine was going again. Had that happened to a diver in the usual form of dress there would have been a dead or dying man in the suit. There promises to be no difficulty in carrying on operations at depths of 300 and more feet. Of course the operator is entirely sheltered within his armored dress, and an ingenious mechanical hand is relied upon to grip and to make the necessary connections with suitable tackle or chain slings. The twelve fingers of this hand are able to pick up a match or a piece of paper laid flat.

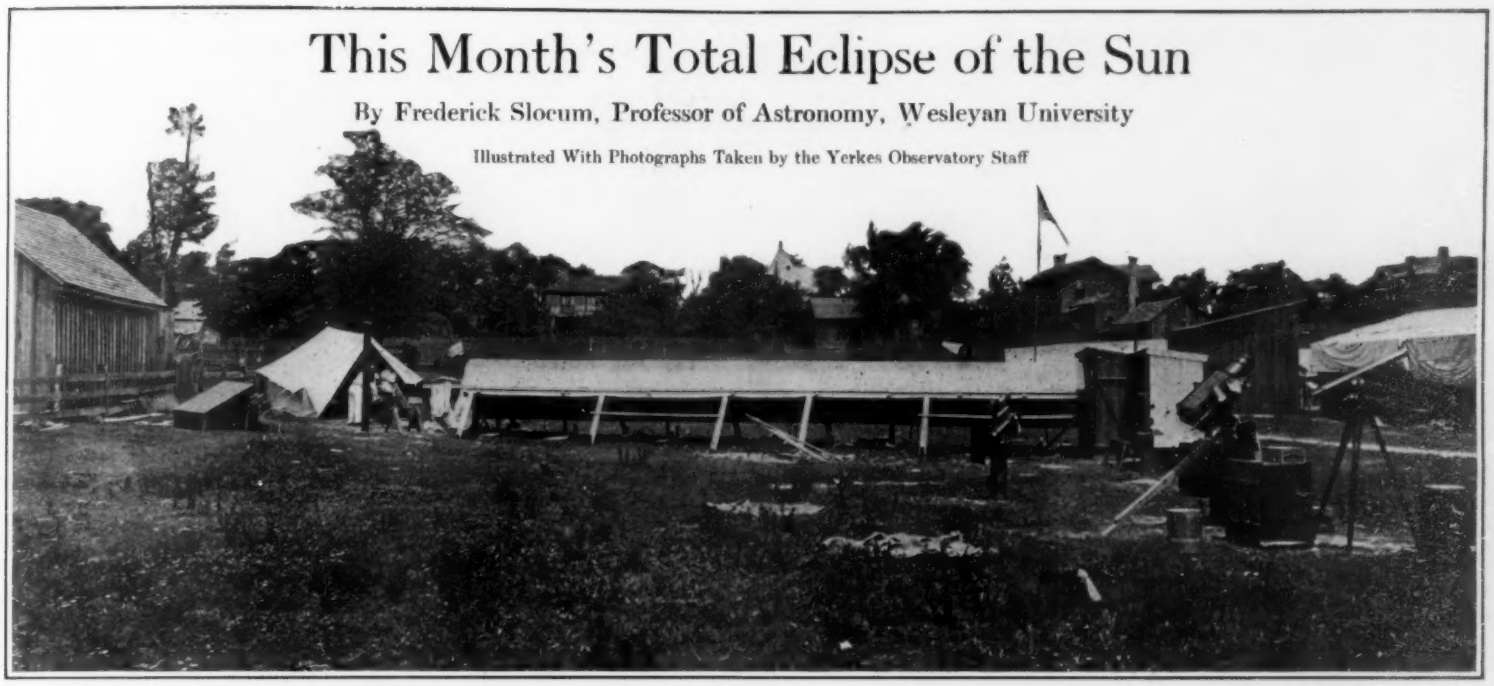
The Macduffee suit is a big stride forward in the art, and should prove of the utmost value in reaching sunken ships that now lie beyond human endurance when the diver is clothed in the best of the elastic suits at present employed. The grim ocean may be forced, in this way, to give up a goodly share of its ruthlessly gained wealth.

Gasoline and Burdock.—One of the readers of the SCIENTIFIC AMERICAN, Mr. D. T. Merrill of Battle Creek, Michigan, assures us that gasoline poured on the head or top of a burdock plant, will kill it, root and branch, and leave a hole in the ground.

This Month's Total Eclipse of the Sun

By Frederick Slocum, Professor of Astronomy, Wesleyan University

Illustrated With Photographs Taken by the Yerkes Observatory Staff



What an eclipse station looks like. This shows the equipment of the Yerkes observatory expedition at Wadesboro, N. C., May 28th, 1900.

THINK of traveling thousands of miles just for the sake of observing the sun for two minutes! That is what scores of astronomers are doing this month. They are traveling at this particular time, because the sun will be totally eclipsed on August 21st, and many of them are obliged to go long distances, because the phenomena will be visible only along a narrow strip about a hundred miles wide, the part of which that is accessible to ordinary travel extending from northwestern Europe to southern Asia.

This narrow strip is in reality the path of the shadow cast by the moon as it passes between the earth and the sun. The shadow first strikes the earth, that is, the total eclipse begins at sunrise, at a point in the Arctic Ocean, north of North America. It then passes northeasterly over northern Greenland, across the ocean north of Iceland, strikes the coast of Norway at Alstenö, thence passes southeasterly over Hernösand in Sweden, across Russia from Riga, past Minsk and Kiev, to the Crimea, across the Black Sea, over Trebizond in Asia Minor, thence across Persia, and finally ends at sunset in eastern India.

It may seem paradoxical to speak of "observing the sun," when the moon is so placed that it completely hides the sun, but, the fact is, it is not the brilliant disk of the sun itself, but rather the solar appendages and the regions around the sun that are studied during an eclipse, and many of these features can be studied at no other time. The reason for this is that our atmosphere diffuses and reflects sunlight, producing a brilliant glare, which blinds the eye to all relatively faint details.

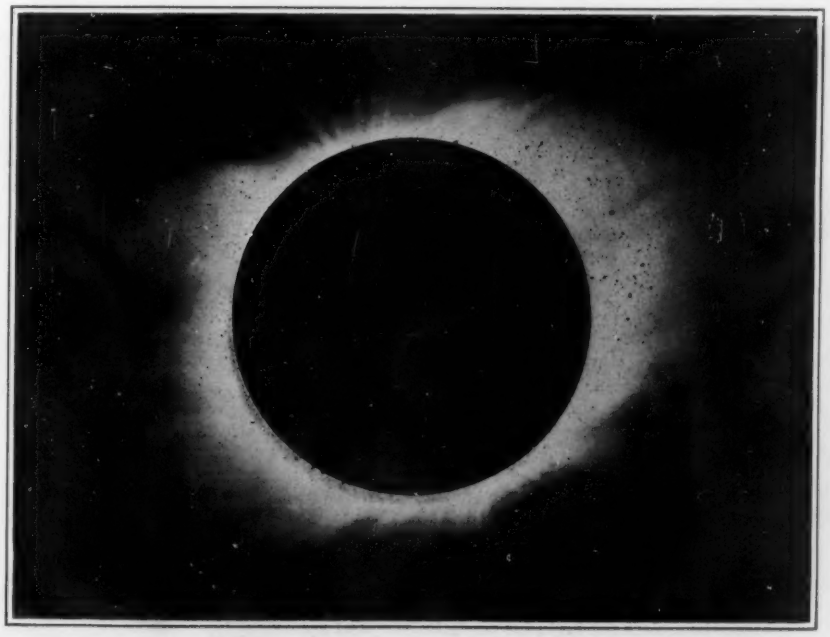
On the moon, which is devoid of appreciable atmosphere, the shadows cast by mountains or by crater walls are intensely black, while on the earth so much light is diffused and reflected that one can see well, even within a house, as long as the sun is above the horizon. For an observer on the moon, it would be possible to hold a screen in front of the sun and cut off practically all illumination, but for an observer on the earth to use a screen effectively, it would have to be placed beyond the limits of the earth's atmosphere, perhaps several hundred miles above the surface of the earth. Such a screen is furnished by the moon on the comparatively rare occasions when it passes directly between the sun and the earth.

Under the most favorable conditions, a total eclipse of the sun may last about seven and one half minutes, but, in general, the duration of totality is much less.

Solar prominences. These are tongues of gas that sometimes rise to a height of several hundred thousand miles.

The eclipse of August 21st will last a little over two minutes. The total time available for eclipse observations during the past one hundred years was a trifle over three hours.

Careful planning is, therefore, necessary to make the most of the few precious seconds available for observations, and stations are selected which give the greatest promise for clear skies at the time of the eclipse. In the case of the coming eclipse, the conditions for observations will probably be best in eastern or southern Russia, but observers will be stationed all along the line from Norway to India. Some of the expeditions have announced their prospective locations.



The solar corona, photographed by the Yerkes observatory eclipse expedition, at Wadesboro, N. C., May 28th, 1900.

The Crocker eclipse expedition of the Lick observatory, under Prof. Campbell and Dr. H. D. Curtis, will be located near Brovary, about ten miles northeast of Kiev, and as near as possible on the central line of the eclipse. The Russian imperial observatory at Pulkova will establish three stations, one on an island in the Baltic, one at Kanev, southeast of Kiev, and one at Feodosia in the Crimea. An expedition under the auspices of the Joint Permanent Eclipse Committee of the Royal Society and Royal Astronomical Society will be located at or near Kiev, the observers being Prof. Fowler, Prof. W. E. Curtis, Father Cortie, Father O'Connor, and Major Hills. The Greenwich observatory will send a party under Messrs. Jones and Davidson to a point near Minsk. The Solar Physics observatory of Cambridge University, England, will be represented by Prof. Newall, Mr. Stratton, and Mr. Butler at Feodosia, and in the same locality will be an expedition under Prof. Perrine of the Argentine government observatory at Cordoba.

The city of Hamburg is fitting out an expedition to be located at some point in eastern Russia. An expedition headed by Prof. Miethe of the Technological Institute of Charlottenburg, Germany, will go to the island of Alston on the Norwegian coast, where the path of totality first touches the European continent. Prof. Todd of the Amherst College observatory has announced his intention of trying to observe the eclipse from an aeroplane in the vicinity of Riga, Russia.

Each party will be equipped with telescopes, cameras, spectroscopes, polariscopes, etc. As the path of an eclipse rarely passes over an observatory, the problem of the transportation of instruments becomes an important one, and instruments intended for eclipse observations are designed with due consideration of the conditions to be encountered.

For example, astronomers going to Asia Minor or Persia are advised to pack their apparatus in pairs of boxes suitable for transportation on the backs of donkeys or camels.

Nearly all nations make special regulations in regard to customs examination and customs duties. The Russian Ministry of Finance has granted permission to import, free of duty, articles and instruments of a scientific character for the observation of the coming eclipse, provided that they are re-exported after the eclipse.

Large telescopes used for eclipse observations are generally mounted in a horizontal position, and the light of the object to be studied reflected into the lens by a system of mirrors. This obviates the necessity of transporting the long tubes and massive piers required in the usual equatorial type of mounting. Fig. 1 shows a group of instruments used by the Yerkes observatory eclipse expedition at Wadesboro, N. C., in 1900.

Formerly, eclipses were observed chiefly for the purpose of correcting the tables of solar and lunar positions and motions, but now the emphasis is laid upon the study of the sun as a star, and upon its radiations. Although merely one of the countless millions of stars in the universe, it is by far the most important from our point of view, and it is so much nearer to the earth than any other star that more detailed study is possible. Whatever we can learn in regard to the sun is just so much knowledge gained in regard to a large class of stars.

The following will indicate the nature of some of the observations which astronomers and physicists will try to make on August 21st:

1. The determination of the times of contact of the disks of the sun and moon.

2. Search for planets and comets by photographing the regions near the sun.

3. Study of the solar corona. (*a*) Small scale photographs to trace the extension of the coronal streamers. (*b*) Large scale photographs for the inner details, and the study of the relation of the coronal arches to sunspots, prominences, and faculæ. (*c*) Large scale photographs through "mercury green" glass to determine the distribution of coronium. (*d*) Study of the spectrum of the corona for the more accurate determination of the wave-lengths of the coronal lines, and to investigate the rotation of the corona. (*e*) The polariscope will be used to determine: 1, how far the polarized light of the equatorial streamers can be traced; 2, whether the polarization of the light in the polar streamers is radial or follows the curve of the streamers; 3, whether the polarization of the light from the blue sky changes during the eclipse. (*f*) The intensity of the radiation of the corona, and the quality of the coronal radiation as compared with that of the sun will be investigated.

4. Large scale photographs of the solar prominences will be made especially for the purpose of comparing the features shown by composite light with those obtained by the spectroheliograph using only the light of calcium or hydrogen.

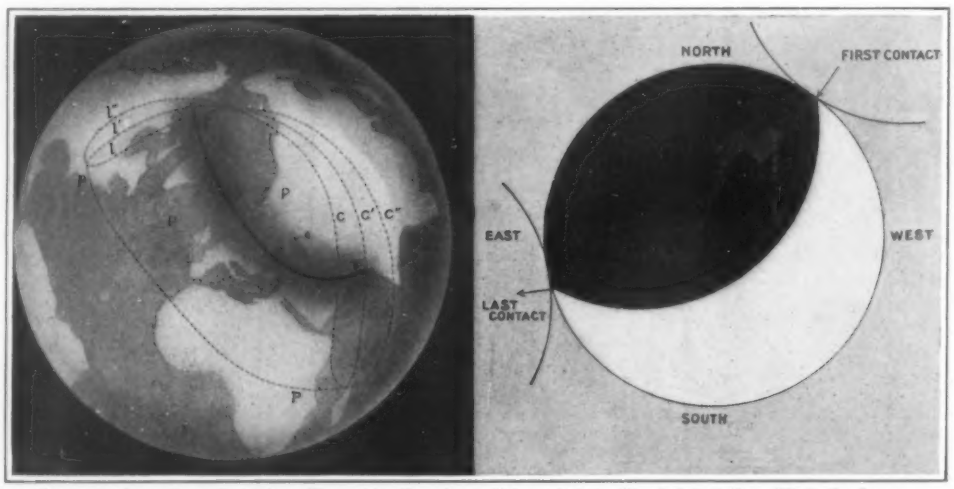
5. Spectra of the chromosphere and of the reversing layer will be obtained in order to investigate the depth of the various known gases, and to search for new gases.

6. An extensive series of observations will be made with wireless telegraphic apparatus to investigate the effect of the passing of the shadow upon the strength and nature of arbitrary signals and stray currents.

Observations with wireless apparatus and photographs of prominences with the spectroheliograph will be made in various places for comparison with results obtained during totality, but, aside from these two lines of research, there will be little interest in the eclipse outside of the line of totality.

In the northeastern part of the United States it can be seen as a partial eclipse just after sunrise. In New York the partial eclipse will last from 5 hours 35 minutes to 6 hours 9 minutes A. M., and in Boston from 5 hours 41 minutes to 6 hours 30 minutes A. M.

The next total eclipse of the sun visible in the United States will occur on June 8th, 1918. The path of the shadow will cross the Gulf of Mexico, the central part of the United States, and western Canada.



Diagram, redrawn from *La Nature*, illustrating the eclipse of August 21st. The full dark line, *TT*, in the figure on the left, is the path of the total eclipse, and is really the path of the shadow cast by the moon as it passes between the earth and the sun. It is only one hundred miles wide, and at any one point in this path the total eclipse will last only a little over two minutes. The shaded portions of the illustration represent water, and the light colored parts land, so the course of the eclipse can be easily traced from the Arctic Ocean, north of North America, across Greenland, Norway, Sweden, Russia, Asia Minor, and Persia, and ending at sunset in eastern India. Outside the dark path of total eclipse, and within the region bordered by the dotted lines, only a partial eclipse will be seen, a condition illustrated in the drawing at the left, but in varying degrees, depending on the location.

The path of the solar eclipse plotted on the earth.

Curious Things About Handwriting

By Dr. Leonard Keene Hirshberg, A.B., M.A., M.D. (Johns Hopkins)

"'TIS hard to say, if greater want of skill appears in writing or in judging ill," quoth the poet. Sound judgment is the ground of writing well, and when philosophy directs your choice, to proper subjects rightly understood, words then will naturally flow from the pen.

"Men write with ease to show their breeding,
But easy writing's cursed hard reading."

The incurable itch to scribble is a natural impulse to the human hand. The inveterate use, however, of the pen rarely changes or improves the scrawl. In sooth, the shape, form, and character of the words and letters are but slightly the outcome of the muscular movements.

For the most part, writing is the upshot of inheritance, childhood discipline, habits of character, temperament, disposition, and what may well be called your chronic mood. Mr. R. H. Chandler has recently devoted great care to the study and investigation of likenesses which exist in the writing of various members of the same family.

So strong is this similarity in some families that it is often difficult for the expert to distinguish one member's hand from another's. Indeed, the same word written by different persons, seems to be written many times by one.

Likeness in handwriting follows the same general principle, according to this investigator, as that which acts in families, as regards resemblances in face, motions, and that family likeness among human beings, which may be defined as an accumulation of indescribably faint suggestions of similiarity rather than any strong identity; for instance, a family likeness may show itself by the color of the eyes, shape of the nose, general outline of face, or eccentricity of manner, but more often it is the *tout ensemble*, something that cannot be put into words and defined accurately, which causes old friends of parents to exclaim, "Isn't he like his father!" or "He is just like his father as a boy." This brings us to another point of agreement between handwriting and ourselves, likeness at corresponding ages. It would be absurd to expect a grandfather of seventy to write like his son of forty-five or his grandson of twenty, but there may be just comparison between the grandfather's writing of middle age and his son's at the present time, or between that of the son and the grandson at corresponding ages. Another point of agreement is what may be called "peculiarities," and the father who has a style of handwriting which shows these peculiarities will frequently bequeath them, more or less unaltered, to his son. Bearing in mind these suggestions, that is, the influence of age on handwriting and the meaning of the expression "family likeness," Mr. Chandler has been unable to collect such striking specimens of the handwriting of women as of men, and it may probably be taken as a general rule that women do not write such characteristic "hands" as men. The vast majority write very much less than men. Besides, most girls on leaving school write a better handwriting than boys at a corresponding age, which does not change so very much through life, whereas a boy usually does not begin his characteristics and permanent handwriting until some years after he has left school. There is a common style of girl's handwriting known as the high school writing. It shows that women write less characteristically than men. It would be rare to find a man whose handwriting had not altered between sixteen and thirty. These remarks apply to women who write a few family letters, and not to a business woman who might write as strong or as pronounced a style of handwriting as any man. That handwriting is an acquired character there can be hardly any doubt. You only inherit the power of learning to write, though it would appear that the members of a family may inherit the power of writing in a particular way. There are, nevertheless, the questions of influence and imitation to be considered.

Charles Darwin long ago recognized that handwriting was inherited, and this idea may be found scattered through scientific literature as an axiom for the past fifty years; but, so far as Mr. Chandler knows, it has not been illustrated before.

The juniors in an office came to write more like their chief as time went on, showing that handwriting is imitative, sometimes to a remarkable extent. In some instances environment has very little to do with it, but in many cases there is so little to know of the influences brought to bear upon such an elastic growth as handwriting, that it is quite possible to underestimate the effects of environment.

Strange Animal Tragedies

THAT almost unerring instinct which carries animals through grave dangers, has led in many instances in the Midway and Sunset oil fields of California to their undoing. Chief among such victims are rabbits and waterfowl.

A jackrabbit and a cottontail find a nice round, smooth hole. There are many such in the oil fields where oil piping is a necessity for the transportation of oil to the refineries. The rabbits decide to set up housekeeping there. The cottontail desires a permanent home, and the jackrabbit wants a refuge safe from malevolent man.

Soon they discover their habitat is being moved. No doubt they are frightened, but they instinctively stay within their retreat. One end of the hole is closed. Even then they do not leave. Soon the other end of the hole is darkened. Then it is darkness eternal for the furry pair.

Some time later it is discovered that a newly laid oil pipe line is choked. After great labor the line is disjointed and the remains of many rabbits removed. Thousands of rabbits have been thus exterminated in the oil fields.

The death rate among waterfowl is even greater. Again, as with the rabbits, instinct leads them to certain destruction. Every little lake of oil in the vicinity of a gusher is a trap for the unthinking birds. At twilight and dawn these tar-colored lakes appear as bodies of water to the deluded fowl.

Great flocks of migratory waterfowl have been seen to drop out of the heavens after sailing majestically above the barren, sun parched desert and plunge into these oil lakes. Pelicans, snow geese, and ducks of all varieties that fly annually between Alaska and the flats of the Colorado River, swoop down to the oily bosom of these lakes. The moment feathers touch oil, their flying days are over. Helplessly the birds struggle to rise out of the gummy mass. Some remain helpless floating on the reeking surface, and are soon overcome by the fumes of gas rising from the oil. Others dive the moment after alighting, as most swimming birds do instinctively when frightened. Strange as it may seem, the sight of fowl struggling in the oil, and of thousands of blackened bodies floating on the surface, apparently fails to deter others from the plunge.

Frost Injury to Plants.—The mechanism of freezing in plant tissues is still a somewhat obscure subject. An interesting contribution to this subject is made by W. Russell, in the *Comptes Rendus*. He finds that the death of a plant through frost does not take place suddenly, but rather cell by cell, and is retarded proportionately to the amount of undamaged tissue. Thus a specimen of *Sonchus oleraceus* destroyed by frost at the end of December, still contained living cells on February 9th in the thick lignified cork ring at the base of the hollow stem, which had been completely decorticated.

The Prospects of Aerial Fighting in the Present War

What May be Expected of Dirigibles and Aeroplanes

By Carl Dienstbach

MEAGER as the news that comes from Europe must of necessity be, there is an excuse for scientific speculation on the most interesting of technical questions to be decided by the present war—the military value of the highly developed air fleets of the powers engaged.

The French equipment offers the least puzzling problems. The war started before any French dirigible was completed even one half as large as the standard German types. If any of those planned and reported building should put in an appearance at the eleventh hour, there would be no question but the lack of any experience in handling units so vastly exceeding in size any familiar standard might prove disastrous under the rough conditions of war. The disaster that befell the British "Mayfly" proved that conclusively.

There is little secrecy about military aeroplaning except as to the number and organization of flyers, which is least known in the case of Germany. Little difficulty has been opposed to studying every detail of French and German army aeroplanes. But of the largest type of German dirigibles, which doubtless are in a class by themselves, very little is known.

The New Zeppelins and the Old.

Barring the latest passenger airship "Sachsen," and the military one that got into temporary control of the French authorities after the famous landing at Luneville, none of the newer Zeppelins has been publicly pictured or described. A foreign traveler who recently attempted to snapshot the "Z I" after it had been damaged in a stormy landing had his camera promptly confiscated. In spite of the secrecy maintained, a close observer can glean not a few important data on the capacity of the newest rigid airships, so far the only representatives of the largest and most potent size of dirigibles, by piecing together odds and ends of news. The most advanced craft—the new naval airship "L III"—has the enormous displacement of 32,000 cubic meters. After a trip of thirty-five hours, at an average speed of 62 miles an hour, it had enough fuel left over for sixteen hours more. That trip touched Basel, Frankfurt, Metz, Bingen, Bremen, Heligoland, Stettin, the Baltic, Potsdam, and Berlin, but not over the shortest distance. Between Metz and Bingen, flying with the wind, a speed of 94 miles an hour was realized. The wireless equipment covered a range, both in sending and receiving, of 469 miles, and kept in communication with Friedrichshafen, on Lake Constance, while flying over Heligoland. "L III" mounts an electric searchlight of 40,000 candle-power, capable of brightly illuminating the ground from an altitude of 4,500 feet, to be used intermittently, especially in casting bombs. Similar searchlights are carried by all German airships.

The second dirigible built for the navy is the wooden "S L II," the second improved vessel of this type. With its new framing, it looks much like a Zeppelin. The hull, however, is more spindle-shaped. Four cars carrying motors of 180 horse-power each are loosely suspended, and one propeller, mounted on the propeller shaft, is directly placed behind each car. There is a navigating car in front and platforms for artillery on both sides, in the center. The "S L II" displaces 23,000 cubic meters and supports a useful load of over eight tons, but it can, nevertheless, reach an altitude of 7,500 feet. The speed is well over fifty miles an hour.

Bomb-dropping Practice With Zeppelins.

In addition to these two naval airships, there are completed eight military Zeppelins; the older ones recently lengthened to increase their capacity, the newer of very considerable size. It goes without saying that the three passenger ships of the "Delag" are by now converted into armed warcraft identical with the rest, and that in the dockyards at Friedrichshafen and Potsdam work is going on night and day on reserve ships. This gives a fleet, barring the "Z I," under repairs, of just twelve rigid, monster dirigibles, to which the enemy can oppose nothing adequate. Successful target practice with machine guns and cannon and in dropping great weights of explosives has been long conducted on these vessels, as well as in the accurate dropping of tons of the highest explosives. The only art yet to be learned is dodging the enemy's fire. That only the experience of actual war can teach. For this reason it seems unlikely that the aerial dreadnoughts will appear at the outset in an aggressive rôle, which would be so much more dangerous than long-range scouting. The potentialities of a skillful use of their fighting strength appear so vast that a commander would naturally hesitate to risk their loss by trying to do too much before experience has become adequate.

Scouting flights, on the other hand, can be made in such secrecy, especially at night, that doubtless many of them could never be reported. Traveling leisurely over great distances, these dirigibles, in enabling the German commander to know exactly how the enemy's mobilization was progressing, would enable him to play a game successfully, which to the uninitiated might appear unreasonable and daring.

Where the French Air Fleet Stands.

The French air fleet's time seems, on the contrary, not yet to have come. Their slow dirigibles would risk much more in starting out on long trips over an enemy's country, not only from attack, but from the craft's own limitations. For very extended aeroplane trips, with only hostile soil below, even the French flyers do not seem to have so far shown great inclination.

Attacking aeroplanes run infinitely less risk than bomb-dropping dirigibles, yet with all the numberless flock of French machines available, one solitary instance of dropping a bomb, near Nuremberg, has been reported. If news about the activities of French flyers is credible, it reads as though they had been governed largely by their individual feeling as to risks to be taken. The attempt at Nuremberg, of destroying a railway far inland where trains are easily switched to another route, seems useless, yet would be less risky than attacking more important and more closely guarded junctions. The ease of bringing every rifle within several square miles to bear on the same aeroplane might account for the alleged shooting down of a French flyer over the fortress of Wesel. It seems especially surprising that not more has been heard of attempts to destroy the all-important dirigible sheds. The news might be suppressed in Germany, but if such plans had succeeded the news would surely have come from French sources. As each shed is surrounded by an aerodrome, it is easily guarded by aeroplane patrols. The great plant in Friedrichshafen is fortunate in being close to the lake, and a great hydroplane factory, that of Potsdam, is being protected by the monster aerodrome "Johannisthal." That dazzling searchlights (blinding an aviator so that he cannot determine the location of the shaded shed) and special artillery will not be lacking seems a foregone conclusion. One might also expect an encampment of infantry, supplemented by machine rifles, to fringe the grounds on all sides, ready to concentrate fire on anything above at a moment's notice.

Protecting German Airship Harbors.

American travelers have reported the mounting of machine guns on the Cathedral of Cologne and on the roof of an hotel in Cologne, but little suspected their true purpose of protecting one of the principal airship sheds of Germany. The French may now regret having neglected the Germans' systematic development of night flying. The stories of the whole night sky between Paris and the Eastern frontier blazing with searchlights read picturesquely enough, but if one remembers that all the searchlights of the fortress of Toul failed to pick up a French dirigible whose time of coming had been announced, they lose significance, if the aircraft's aim is merely unobserved passage. Nothing is seen at a distance and dodged so easily as the long, pale shaft of a searchlight. If target practice against the ground with cannon should be equally far developed as against aerial foes, to plant a shell from afar out of the dark at some point guarded by a searchlight, without the risk of being detected—which in dropping bombs would be very real—seems perfectly feasible, but hardly worth trying, when victory itself depends on gathering information without the enemy's suspecting it. At war altitudes, Zeppelins are now perfectly silent. With their great internal resources they may now be hovering, nightly, over the enemy's country for whole nights, reporting observations by their long-range wireless, as unseen as the English cruisers now off New York. Little of the "L III's" 35-hour trip could be traced from the testimony of observers on the ground, although most of it was made in daylight and there was no attempt at concealment. Great damage could doubtlessly be done by bomb dropping, but the possible usefulness would hardly justify the risk of being set upon by flocks of aeroplanes. A Zeppelin is too hard to replace, compared to an aeroplane, to risk it in an air battle as long as it can influence the issue far more by silent, unsuspected scouting at long range. The chances for attack by Zeppelins will be much improved after the mass of French aeroplanes is established in the field with the army. French dirigibles hardly count, as they are quite as vulnerable, cannot mount real cannon on top of the gas bag, and are hopelessly outclassed in speed.

France has recently completed a squadron of armored aeroplanes, carrying great weight, but they are comparatively slow, and their armor offers no protection against the Zeppelins' shell fire. No doubt they will be needed for risky scouting at the front. It does not look as though this war, except for the Zeppelins, would be very different from the conflicts in Tripoli, the Balkans, and Mexico, except for its vastly larger scale. The many French and Russian dirigibles would not seem to count for much, because they are too slow, insufficiently armed, and therefore far less prepared to fight aeroplanes than the German dirigibles, while inferior radius of action and speed makes secret scouting also more difficult. They have not even claimed, so far, to have made good their former threat of destroying the Rhine bridges during mobilization. The most formidable dirigible so far constructed in France, a medium-sized Astra Torres, is in English hands, and the English possess in their Parseval also the second fastest airship of the Triple Entente. The readiness of the German government in allowing the sale of that Parseval speaks volumes for the superiority of the larger type.

Russia's Aeronautic Inefficiency.

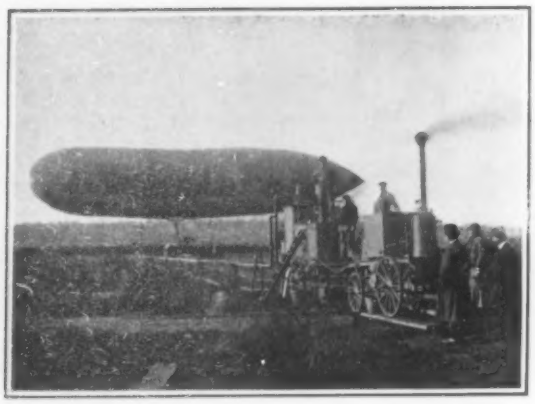
There is one more unknown factor—the Russian mammoth aeroplane. Its speed is little more than that of a Zeppelin; its radius of action with adequate load very much less, and its use over hostile country beset with the gravest risk, due to its dependence on good ground for starting and landing its ponderous bulk. It is also equipped with German motors, and new motors would seem hard to procure even from France under present conditions. The whole Russian aeroplane fleet was incomplete when the war broke out, arrangements having been made just previously to add more than two hundred. If Russia should be left for some time to its own mechanical resources, it would be worth while to know that, as a well informed Finlander told the writer a year ago, she boasted then of one automobile factory in the whole empire, whose sole customers were grand dukes and high officials.

The ordinary type of military aeroplane following the troops and operating right on the battle ground may be expected to be much in the foreground in a war that started at the present development of military aeronautics. Its rôle will not appear so spectacular since we had become used to it in previous wars. But, due to the immense number of such machines, we may not only expect frequent instances of inconclusive bomb dropping, but irregular, unsystematized fighting in the air with machine guns or rifles. All indications point to the fact that hostile aeroplanes can avoid clashing in the air at least as easily as cruisers at sea. Aerial tactics have hardly been perfected. Only if French or English aeroplanes went after Zeppelins, which received them with machine gun and artillery fire, and German or Austrian aeroplanes came to the rescue, would we be likely to see some lively fighting in the upper regions. The regular army machine gun, weighing some fifty pounds, has been known as a regular installation only on specially heavy French fighting aeroplanes, owing, no doubt, to the weight of ammunition required for sustained fire. But there are lighter types, and we may expect at least a rifle or automatic pistol on any air machine. The French have at least one specially large aeroplane mounting a light cannon. But it is a foregone conclusion that the ammunition supply of such a gun must be very limited if compared to that of a 30-ton Zeppelin, and close proximity of gun and motor with resulting vibration will make aeroplane fire much less certain than Zeppelin fire.

Theoretically, Zeppelins, by the efficiency and range of their fire, could be employed to keep away aeroplanes from positions which it would be imperative to conceal, better than other aeroplanes. But, owing to the immense number of French aeroplanes compared to the number of Zeppelins, this use could be resorted to only on very special occasions. It will hardly be expected as long as long-range scouting remains, a much more important task for Zeppelins.

As long as the new aerial equipment is still so very small compared to the old-fashioned fighting apparatus, scouting in the air will take precedence over fighting.

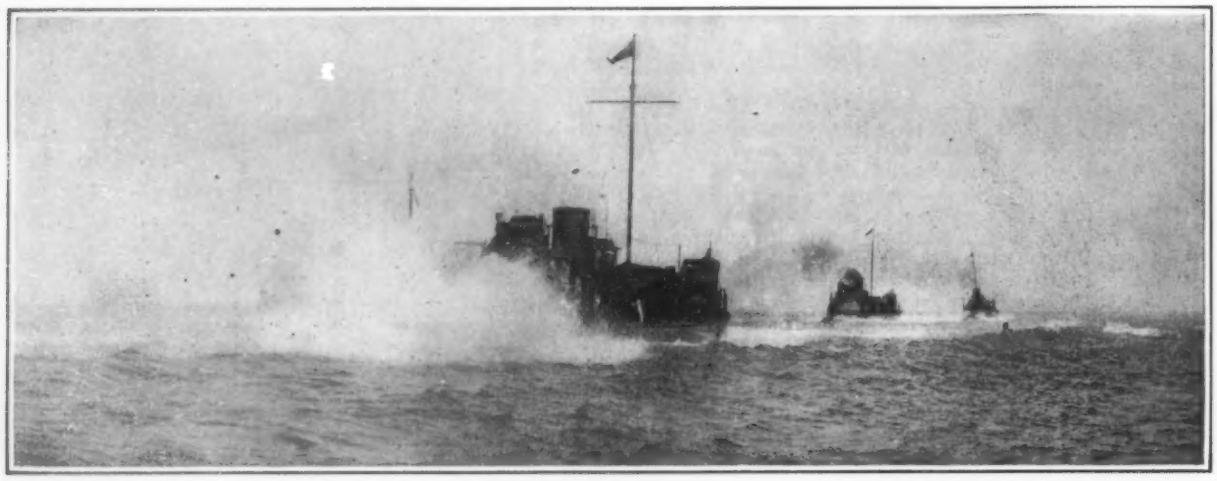
The Imports of Matches into China greatly exceed in value any other wood product. Most of the matches come in from Japan.



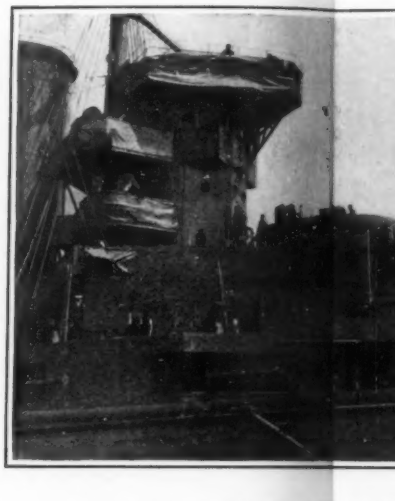
Charging a Parseval dirigible with gas.

A Russian supply train.

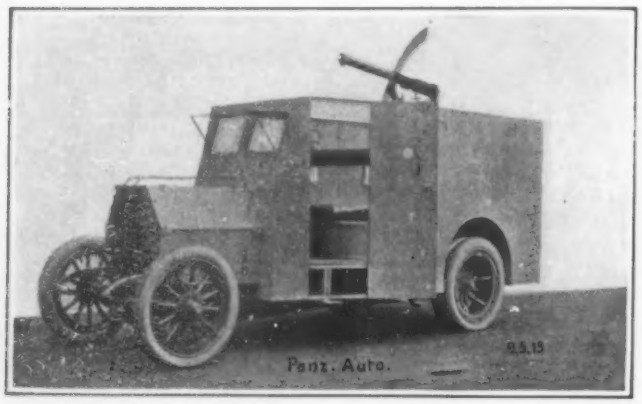
The Emperor of Germany revie



A group of British torpedo boats.



Conning tower and bridge of British ba

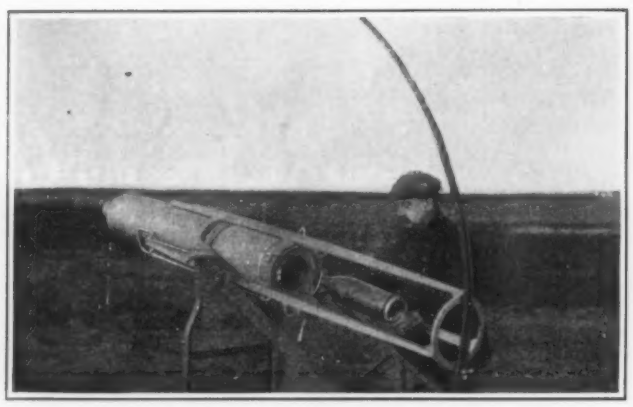


German armored automobile with machine gun.

German 7.5-centimeter aerial gun in transit.

English field artillery hauled by

German 7.5-centimeter aerial gun in firing position on motor truck.



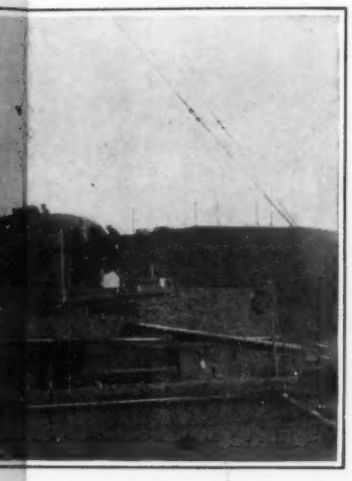
German 13-centimeter bomb-launching tube for airships.

Dreyse (German) machine gun for

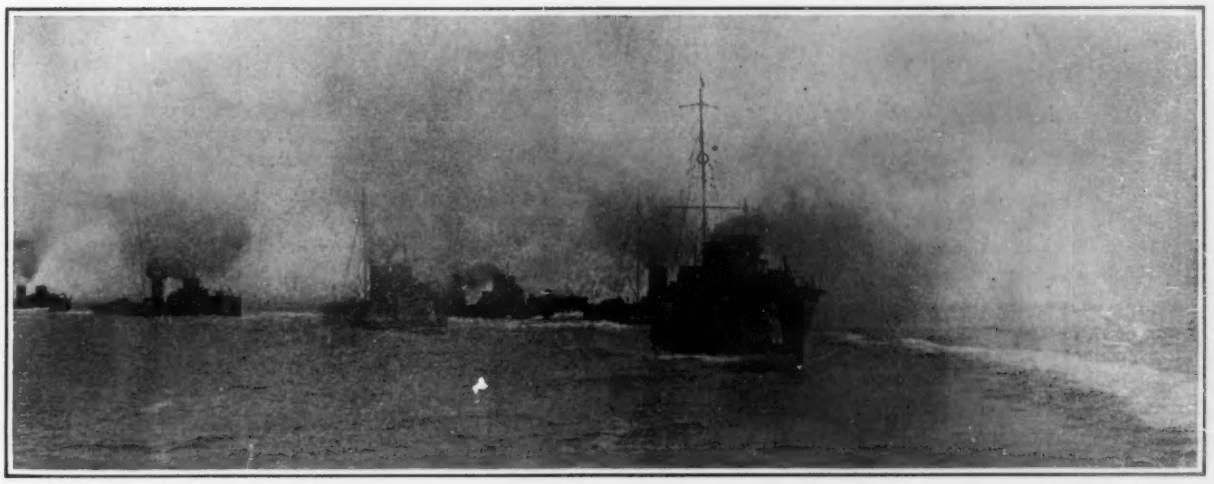
rmany reviewing the Uhlans.

French infantry in the field.

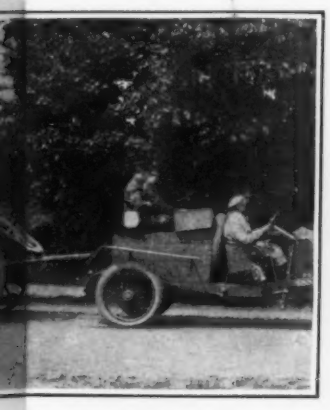
A Russian cavalryman in marching order.



f British battle-cruiser "Lion."



Division of German destroyers in maneuvers.

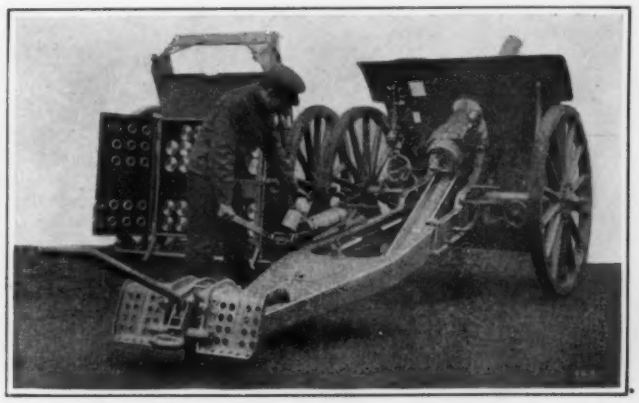


y hauled by automobile.

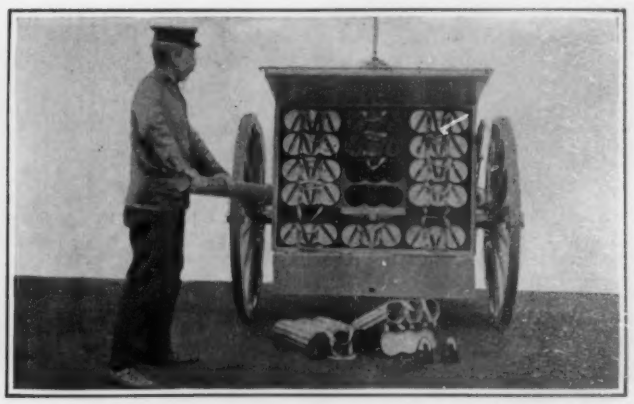
Hauling back a German 21-centimeter mortar for transport.

German 28-centimeter mortar in battery.

ine gun for firing at aircraft.



German 10.5-centimeter howitzer with ammunition cart.



German ammunition cart. Shells for 9.5-centimeter howitzer.

GHTING MACHINERY NOW IN ACTION

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

A Relief Map of the United States

To the Editor of the SCIENTIFIC AMERICAN:

A relief map of the United States, executed on a large scale and suitably housed, should prove most interesting and instructive to the public. A horizontal scale of 1 to 50,000 and a vertical scale of 1 to 400 would probably be suitable; but such details would have to be determined by experts. A special building would be required for the proper protection of the great map, and this should be provided with suitable galleries, and perhaps with a traveling crane.

The cost of the whole outfit might be as much as a million dollars. As the exhibit should be under the cognizance of the Weather Bureau or some other Government office, the necessary outlay should be borne by the national treasury. It follows that the best location for the structure would be at the national capital.

The structural problems involved would be, I think, not at all difficult. T. W. KINKAID.

Annapolis, Md.

The Fallacy of Eternal Youth

To the Editor of the SCIENTIFIC AMERICAN:

Being especially interested in the discussion of this subject as given by J. A. Guthrie in correspondence column of SCIENTIFIC AMERICAN of August 1st, 1914, the writer of this letter feels prompted to offer another link to the chain of argument presented in original letter under above caption.

The concession is being frankly made by the scientist that under the influence of a primitive system of hygiene and sanitation, all functions of the human body were maintained at such perfect balance as to establish an antediluvian longevity that placed the maximum limit of life close to the 1,000 years mark.

In such case natural death resulted not so much from the breaking down and disintegration of molecular cells, but rather from the gradual and mutual "slow-down" of the entire machinery of life, and at a time when there were few marks of decrepit old age, or the presence of organic disease upon the body to disturb or destroy its vital organism.

Like the apple that falls from the bough only as it attains to complete ripeness, so real old age and death come when the purpose of life in this world would have been fully met, as in the recorded instances of Moses, who stepped from the stage of human action at a time when his eye had not become dim or his natural force abated. L. J. HEATNOLE.

Dale Enterprise, Va.

Neolithic Man in Arkansas

To the Editor of the SCIENTIFIC AMERICAN:

In Madison County, Arkansas, a railroad is being constructed from Combs, on the White River, about fifteen miles to Cass, Ark. In going this distance, this road passes over the ridge or rim of what is known as the Boston Mountain. The road passes through a low gap in the rim; just after passing this narrow ridge, there was not sufficient space on the ledge to construct the road, and blasting was resorted to, in order to furnish room on the right of way; and huge masses of sandstone were blown out of the side of the mountain.

A little later workmen were using these, breaking them up with heavy sledges and placing them as ballast on the track.

Last week two workmen broke open a large fragment with their hammers and it was found to contain a stone ax. The ax was well fashioned and showed that evidently it was the workmanship of Neolithic man; the ax was firmly and fully imbedded in the substance or matrix of the rock, and the rock furnished a good cast of the ax, where the ancient tool was loosened and taken out.

Above the ledge from which this rock was blown there is fully seventy-five or one hundred feet of sedimentary longitudinal strata, known as the "Winslow formation." The ledge from which the ax was blown is evidently the lower stratum of the Winslow formation, or the upper sandstone stratas of the "Morrow formations." There was no evidence of any cave formation where the ax was found. The formation was solid strata.

How long has this ax been there? Evidently it was dropped in water, at or near the shore of this ancient coast line of the Gulf of Mexico, when the great Boston Rim was a circular island, some sixty miles from rim to rim, and in the shape of a horseshoe, with the opening to the west. The substance into which this ax was dropped and into which it sank was the then soft beach sand on the shore of this island, which is but one of the archipelago of curious circular ridges that form what is known as the low range of the Boston Mountains. These confront the Gulf of Mexico.

Evidently after the ax was lost the archipelago sank, and remained there long enough for seventy-five or one hundred feet more of strata to be formed. And then the gulf receded away to the south.

How long has this been? On the summit and sides of the hills and to the north, in the central lagoon of this ancient island, are to be found many stone mortars and stone hoes, showing that there existed considerable population, and this ancient man was something of an agricultural being.

But the great question arising seems to be not the newspaper query, "How old is Ann?" but the more scientific paleontological inquiry, "How old is Neolithic Man?" DR. E. G. DAVIS.

Kansas City, Kan.

The Moon's Craters

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of April 4th, No. 14, I was very much interested in the article "Origin of Structures on the Moon's Surface," as this topic has occupied my attention many times.

Fig. 1.—Scrap of iron exhibiting lunar structures.

Fig. 2.—A possible explanation of the moon's craters.

I beg permission to suggest the following explanation, according to my way of thinking: The moon, from whichever celestial body it came, is composed of almost pure iron like meteors and cosmic dust, and, having traversed a great extent of absolute vacuum, in a molten state, expanded into a huge porous or hollow sphere, comparable, in form, to a particle of cosmic dust which continually bombards our planet.

On examining a scrap-pile in an iron foundry, it is not uncommon to come across some pieces of iron exhibiting some of the structures seen on the moon (Fig. 1). The lunar structures are very different from one another and bear very little resemblance to our volcanic craters. Some are narrow and deep, while others are shallow and very wide; some present a central cone, while in others this feature is entirely absent.

Let us imagine a huge mass of molten iron, full of gas and steam pockets, hurled into vacuum. As it assumed the spherical shape, the gas and steam contained in it expanded rapidly and issued everywhere out of the surface like geysers, throwing molten metal in all directions and producing a sort of earthquake. The vibration at each vent that burst out set up annular waves in the surrounding molten substance, which caused the widening out of the craters into large rings.

The bright patches called oceans are smooth surfaces of the metal which kept its metallic luster, owing to the absence of atmosphere.

To reproduce these phenomena in the laboratory, take a common rubber ball and perforate it in several places with a very fine, hot needle; this being done, dip it in very soft plaster mixed with a little soap, to represent molten metal containing gases, and force a constant stream of air into it until the plaster is quite dry; then notice the change that takes place on its surface (Fig. 2). My experiment as illustrated in the photograph is very crude, as I have no means of doing it as I wished to do; but, if I had taken a perfectly round ball and had given it a more even layer of plaster, the results might have been much better. I made the holes too big. That is the reason why they opened out so much. Anyhow, it gave me the very results I looked for. Somebody else might do better using the data here disclosed. R. W. T.

Joinville, Brazil.

Subsistence in the Present War

THE question of subsistence is a vital one to an army, and many battles have been lost from the failure of food supplies. The commissary department of armies in all civilized countries is in the hands of men who are in reality dietetic specialists on a large scale. The present war is the supreme test for the quartermaster's department.

"Rations," as the daily food supply of the soldier is known, vary in each country according to racial tastes or climatic conditions, thus, the meat ration of France is quite different from that of Germany. For the purpose of comparison we have taken the daily field ration of the German army, which is as follows:

750 grammes of fresh bread,
or 500 grammes of biscuit;
375 grammes of raw meat (fresh or salted),
or 200 grammes of smoked beef, pork, mutton, bacon, or meat sausage;
125 grammes of rice (groats),
or 250 grammes of pulse or flour,
or 1,500 grammes of potatoes;
25 grammes of salt;
25 grammes of coffee (roasted),
or 30 grammes of coffee (green),
or 3 grammes of tea and 17 grammes of sugar.

We have shown this supply for a week compared with the huge mass of Cologne Cathedral. The result is very surprising, for we have a loaf of bread weighing 60,130,000 pounds and 393 feet high, which bulks well alongside the lofty edifice. Meat is represented by a side of bacon, but in practice this might be varied by sausage, smoked beef, fresh beef, salt meat, or mutton. The bacon is 180 feet long and would weigh 16,030,000 pounds. Potatoes are the heaviest item, weighing 120,330,000 pounds, and the gigantic tuber shown in the engraving would be 188 feet high and of a proportionate girth. The bag would be two feet less in length, while the sugar bag would measure 38 feet high and would weigh 1,365,000 pounds. Such amounts of food seem almost incredible.

Of course, the figures given are for the standard ration, which is probably a very different thing from that actually being consumed along the great battle formation, for there is great flexibility as to the food to be used. It is possible that pemmican (a condensed meat product) has entered into the ration very largely, but we will not get much accurate information until the close of the war. The Kaiser has always expressed a lively interest in the soldiers' food, and he has not infrequently ridden up to the field bakeries and sampled the product of their ovens.

Some idea of the enormous expense of the war will be gained when it is stated that the daily cost of provisions for the combined armies would be $12,500,000 without the expense of transportation, which would be $4,200,000 more each day. These figures were based on a comparison of prices of some years ago so that 15 per cent could be added to the cost of the food, making the cost $18,750,000, or $22,950,000 "delivered" at the place of consumption. This is truly an enormous daily bill of the war butcher, war baker, and war grocer.

A Novel Shock Absorber.—In a patent, 1,104,380, to Peter K. Olechna of Schenectady, N. Y., is shown a shock absorber in the form of floating spring supported frames to which the axles of the machine are connected in such manner as to cushion shocks both fore and aft.

Russia's Giant War Flyers

The Sikorsky Aeroplanes and How They Are Constructed

By Major H. Bannerman-Phillips, Aeronautical Correspondent of the Scientific American in England

THE ideal mechanical flying machine, which relies for support in and progress through the air upon aerodynamic resistance alone, should be one that transports the greatest load in the shortest time for the least expenditure, but it goes without saying that this is not necessarily the ideal for a specific purpose. For instance, in a machine built for military purposes, and more especially for scouting, speed is essential, other considerations being quite subordinate, though desirable. In discussing any type of aeroplane, therefore, and its main points of design and construction, we must first of all know the purpose for which it is designed. Is that purpose a definite one, and is it to be accomplished regardless of other considerations?

The Tendency to Specialize.

During the past twelve months or so the tendency for makers and designers to specialize in machines intended for specific purposes has been very noticeable, and it is well that it should be so. Although we may hope that in due time the aeroplane will be used for other than warlike or sporting purposes, it is evident unfortunately that at present it is only a hope, and when one takes up the discussion of large aeroplanes, such as the Sikorsky machines, it is mainly with a view to understand their suitability as war machines, for no heavier-than-air flying machine in the present state of development of the art of construction can be regarded seriously as an ordinary passenger carrier for the promotion of human intercourse, either from the point of view of economy or safety.

The Sikorsky a Warcraft.

With regard to the huge machines designed by Sikorsky, it is very certain that speed is not the main quality striven for, but steadiness, power in the form of airworthiness, and weight-carrying capacity, either in the shape of passengers, fuel, or gun and ammunition, bombs, searchlights, and wireless telegraphic apparatus. In discussing these machines it must be remembered that the whole of Russia is forbidden to foreign aircraft. As these notes are being written it is reported in the press that a German Zeppelin, which strayed across the frontier, was promptly fired upon by the frontier guards. Little information as a rule leaks out as regards progress in Russian naval or military aeronautics, and such items as appear in the press can only be taken as straws which may possibly serve to show which way the wind blows.

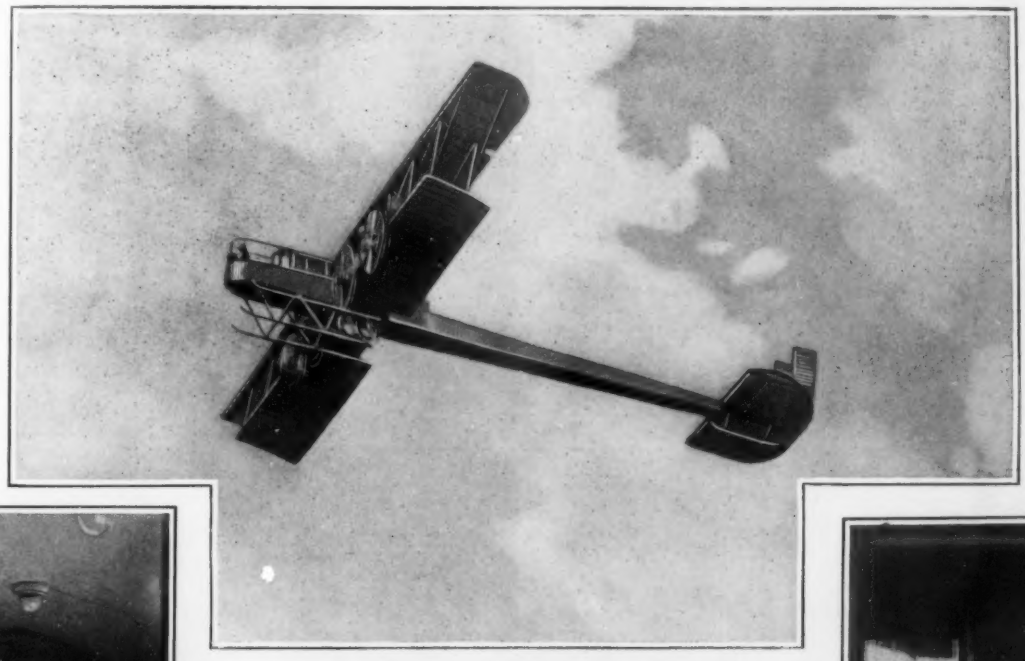
For Sea as Well as Land.

It is understood that not long ago five Sikorsky machines had been ordered for the Russian Admiralty to be fitted as sea-planes, in addition to a number which had been ordered for the army, but whereas we in England have good cause to know by now from a tolerably wide experience, that a good aeroplane for land service requires something more than the addition of floats in order to convert it into a sea-plane, there are no details to hand as to the proposed Sikorsky hydro-aeroplane.

Great Flights with New Motors.

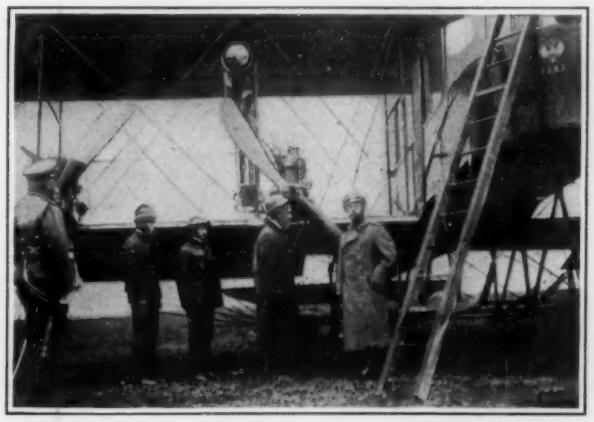
On the other hand, it is stated in the technical papers that on the 25th of June, M. Sikorsky established a record by flying for 6 hours 33 minutes 10 seconds with six passengers *during the night*, and that during the same day, with ten passengers, he reached a height of 2,000 meters, or 6,560 feet, in 1 hour 26 minutes 21

(*Continued on page 138.*)



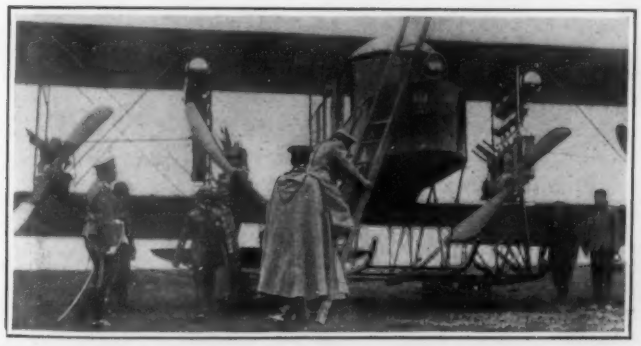
The huge Sikorsky machine in flight.

A glimpse of the interior arrangement.

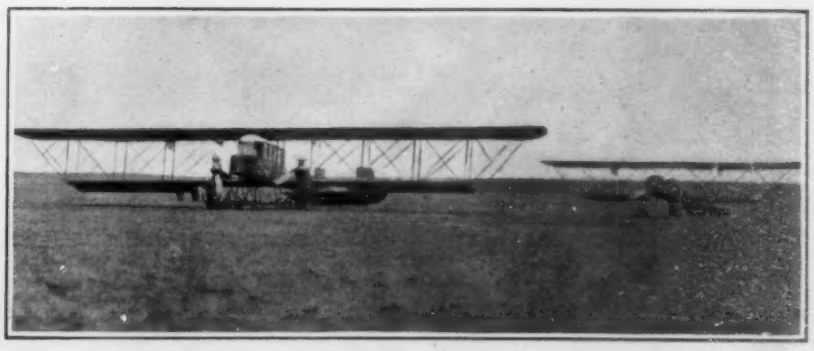


The Czar inspecting the Sikorsky machine.

The pilot house.



Russian dignitaries climbing into the machine.



The Sikorsky machine compared with a standard biplane.

John P. Holland

JOHN PHILIP HOLLAND, the inventor of the submarine boat, died at his home in Newark, N. J., on August 12th, in his seventy-second year, as the result of an attack of pneumonia, which seized him early in July.

Mr. Holland was born in Ireland, and at one time was a school teacher. His attention was directed to submarines by the news of the fight between the "Monitor" and the "Merrimac," which revolutionized navy construction, and it set him to thinking how it could be revolutionized again. The result was the conception of the submarine, which he developed and perfected only after years of study and experiment. In the year 1875, after fifteen years of serious work, Holland produced what he believed to be a practical vessel for underwater warfare, and submitted his designs to the United States Navy Department. The engineers who examined the plans are said to have reported that while the craft was practical, still its operation was so dangerous that no one could be found to undertake the work, and the plans were rejected.

Mr. Holland was described as a quiet, retiring man, but possessed of great determination and tenacity of purpose, and this is demonstrated by the fact that notwithstanding this rejection by the Government, and the many satirical and unfriendly comments by the public press, he persisted in his enterprise, and at once began to study how to overcome the objections of the Government experts, devoting eighteen years more to the task. In 1893 he submitted plans for an improved boat, which met with approval, and an appropriation was authorized for the construction of the new craft, but owing to disagreements with the naval engineers the plans were withdrawn, and Holland and his associates built an improved craft on their own account, which proved so successful that the Government bought it after a most satisfactory demonstration of its capabilities.

The Forfeiture of German Patents in England as a War Measure

ACCORDING to a newspaper dispatch printed in the Washington *Times*, W. L. Runciman announced in the House of Commons that the Board of Trade is now considering releasing, for the use of the British manufacturers, all patents owned by Germans that are registered in the United Kingdom.

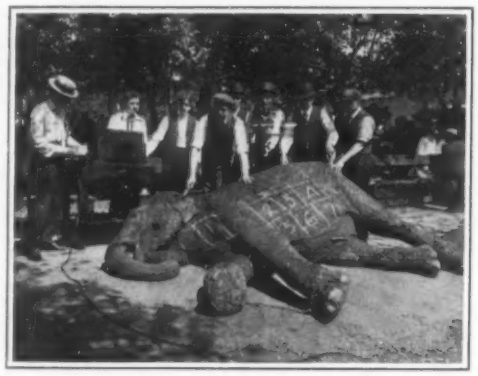
If this measure is actually approved and enacted, which we can hardly believe possible, it goes without saying that Germany will retaliate. To be sure, the great German chemical manufacturers might lose much by having their English patents revoked. On the other hand, the damage which British inventors, particularly inventors of mechanical appliances, will sustain, will be equally great. It seems incredible that either nation would be so foolish as to destroy intellectual property in this way.

Manicuring a Lioness

THE wild animals in our menageries, cooped up as they usually are, in narrow cages, although intended by nature to live a free roaming existence, are very apt to have trouble with their feet. The nails do not wear off as fast as they grow, and they become uncomfortably long, making it necessary to pare them off from time to time. In some cases, trimming of the nails is necessary to lessen the danger of attacks by ferocious beasts upon the keepers. At any rate the services of a manicurist are frequently required in zoological parks. As may be imagined, the operation, particularly in the case of a lion or tiger, is most dangerous. The accompanying photograph shows "Trilby," a lioness at Lincoln Park, Chicago, undergoing this trying, but very necessary operation. "Trilby," it may be remembered, is the animal which recently killed her trainer, Emmerson Dietrich, in a box car. The man who is cutting her claws is Cy de Vry.

X-Raying an Elephant in Search of a Diamond Ring

TO find the location of a $450 diamond ring which she had accidentally swallowed, Minnie, a trained



X-raying an elephant in search of a diamond ring.

elephant, performing at a Cincinnati summer resort, was compelled to submit to being X-ray photographed.

The elephant was eating peanuts out of the hand of a man wearing the valuable ring, when playfully she slipped the saliva-covered end of her trunk over the

The Rocking Stone of Tindal.

fingers of the hand in search for more peanuts, and to the astonishment and consternation of the man, took the ring along in withdrawing it. Quickly she tossed it into her yawning mouth, heedless of the futile efforts of the owner to make her drop it.

To locate the ring X-ray photography was resorted to. Minnie's side was marked off into seven sections and seven X-ray plates were marked to correspond with the numbers painted on her side. One after another the photographs were made of her interior in an effort to find the exact location of the missing ring. It showed up in plate No. 1. The ring had become firmly lodged in the throat of the elephant, and she could not cough it up nor would it go down. A veterinary surgeon was summoned, and he probed the animal's throat for the ring. The valuable gem was soon recovered and the elephant was none the worse for her novel experience.

The Trade Routes

THE war in Europe has not only interrupted international trade, but it presents serious difficulties which must be surmounted before a normal movement of merchandise is possible along the old trade routes. With this abnormal condition great consumers of wealth abroad, their European supplies having been cut off, are looking to the United States for merchandise.

The American manufacturer is not only prepared to meet these foreign demands, but he is confident that with the establishment of friendly trade relations, he will be able to compete with Europe and retain his new foreign customers after treaties of peace have been signed. This is indicated by the steps which are being taken to develop the new trade routes on a permanent basis, which is evidenced by the many trade-marks which are being registered abroad by citizens of the United States.

The Rocking Stone of Tindal

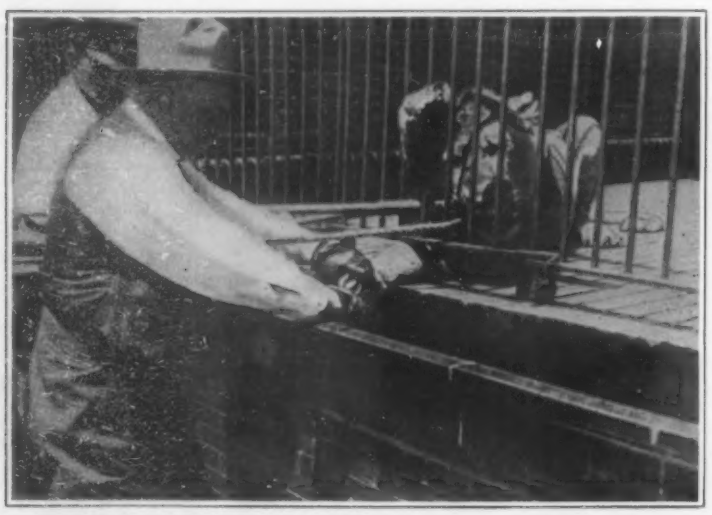
EVERYONE has heard of rocking-stones—masses of rock so delicately poised as to move backward and forward upon the slightest impulse. Until quite recently the giant among these curious phenomena was the famous Rocking Stone of Tindal, in South America, which fell, for what reason is unknown, a few months ago. Existing rocking stones were mere marbles compared to the Tindal. It weighed something like 700 tons, was composed of granite, paraboloid in shape, and measured some five meters in height. It was ingeniously poised upon a knob of rock in a low range of hills some 250 miles south of the city of Buenos Aires.

Under-water Weed Cutter

A NOVEL mowing machine has been built by a resident of Silver Lake, Wisconsin, for mowing down submerged growths in lakes and streams. The apparatus is mounted upon a flat bottomed boat, the lines of which are curved to insure easy running and steering. The boat is 15 feet long and 4½ feet wide with a paddle at the rear driven by a side shaft connected to the paddle wheel by bevel gearing. The side shaft is driven by sprocket chain connection with a gasoline engine. The side shaft extends to the front of the boat, carrying a pitman adapted to oscillate a sickle or cutter. The oscillating sickle moves in contact with a stationary one, which acts as a guard, but does not clog in the mossy weeds. The sickle is raised or lowered at will by a single operator. The lever for raising and lowering the sickle may be seen at the left in the photograph. Weeds may be cut in water as shallow as 10 inches and as deep as 4 feet, the swath being 10 feet wide. When cutting the boat makes a speed of 4 miles per hour.

Polishing Pearls

PEARL ornaments may be elegantly polished by first rubbing with olive oil to remove the dirty appearance, then applying any red nail polish. This latter gives a burnished appearance, and with a little fast rubbing the pearl takes on a brilliant glow.



Trimming "Trilby's" toe-nails.

Mower boat for cutting submerged weeds.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

GARMENT.—A. GOLDBERG, 134 W. 26th St., New York, N. Y. This improvement refers particularly to a skirt having a placket opening, a closing member for said opening, and common means for drawing the edges of said opening together to adjust the garment to the wearer and for securing the closing member over the placket opening.

Electrical Devices.

ELECTROLYTIC APPARATUS.—J. D. FIELDS, Butte, Mont. This inventor provides a novel electrolytic apparatus for the treatment of ores, especially copper ores in which the metal is deposited from a solution. The use of the apparatus results in a large economy of floor space, this being an important item in a large reduction plant.

Of Interest to Farmers.

CULTIVATOR.—C. F. DAVIS, Arausas Pass, Tex. This combined harrow and cultivator is especially adapted for cultivating small plants, such as cotton, corn, and the like, wherein mechanism is provided for quickly adjusting the cultivating mechanism to the plants, whether the said plant is on a ridge or on the level or in the furrow.

ATTACHMENT FOR GRAIN DRILLS.—M. L. AKERS, Pendleton, Ore. This attachment is to be applied to grain drill boots or hoes, and the device can be readily applied to the hoe of ordinary drills, and will serve to effectively sustain the weight of the hoe and permit of the ready adjustment of the shoe to regulate the depth of seeding the grain.

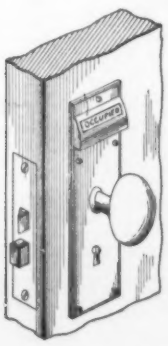
Of General Interest.

BEAD CROCHETING NEEDLE.—CHARLOTTE I. DENNER, Route No. 2, Santa Rosa, Cal. In this invention the loop is strung with beads arranged as to color and number in reverse order to that in which they are to be used, both sides, if necessary, of the loop being

BEAD CROCHETING NEEDLE.

strung, and as the work progresses the beads are slipped down from time to time over the loop of thread on the hook, the needle being momentarily lifted from its saddle in order to let one or more, as required, of the beads slip down over the lower end of the needle.

INDICATING DEVICE.—CARL G. WEVAT, 1 Elizabeth St., Bordentown, N. J. This invention has particular application to a device for indicating the condition of a room, bath house, locker, or similar place so that a prospective occupant will be advised as to whether the locker, room, or bath house is occupied or open. In carrying out this purpose the inven-



INDICATING DEVICE.

tor provides a device which will be operated from the bolt of the door lock and which will be constructed in such manner that when the bolt is in locking position a signal, indicating that the room is occupied, will be displayed, while when the bolt is retracted, the signal displayed will indicate that the room is open.

Hardware and Tools.

EXPANSION NAIL.—G. C. RAEGER, Waterloo, N. Y. The object in this case is the provision of a new and improved expansion nail for use in concrete fence posts and other structures, and arranged to permit of conveniently applying the expansion nail and to securely fasten a fence wire or other article in place.

FILE.—O. G. SIMMONS, care of Wissler Instrumental Works, 611 N. Broadway, St. Louis, Mo. Among the objects of this invention is to produce a file preferably of the flat face surface type, adapted especially for the finishing of fine work, the teeth of the file being arranged and formed in a peculiar manner with respect to one another and the body of the file.

Heating and Lighting.

AUTOMATIC IGNITION SYSTEM FOR GAS LIGHTS.—J. W. LUNDAHL, Thomaston, and O. A. EKSTROM, Litchfield, Conn. Address the former, Box 585, Thomaston, Conn. This invention is especially adapted for use in connection with automobile lamps, whereby the driver can light the lamps by a single controller without moving from the seat, and while useful in this connection, it is understood that it is applicable for house and other lighting systems where the burners are to be lighted from a remote point.

FURNACE DAMPER REGULATOR.—R. M. HYDE, Westfield, N. Y. This invention automatically regulates the dampers of furnaces used in vapor or low-pressure steam-heating systems. It provides means for regulating the dampers, said means comprising a device of the gasometer type with a device for preventing the forcing of the water in the gasometer out of the same by the steam pressure, and also for preventing the entrance of air into the gasometer when the steam pressure has been lowered.

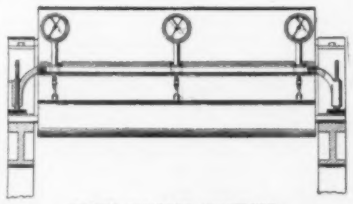
Household Utilities.

GAS BROILER.—G. W. MURRAY, 210 N. Carolina Ave., Atlantic City, N. J. This broiler is more especially designed for broiling meats and other food products, and arranged to subject the meat to be broiled to the full upward force of the heat to insure proper broiling, to protect the gas jets from becoming clogged up by drippings from the meat during the broiling operation, and to shield the cook from the flare of the gas flames.

Machines and Mechanical Devices.

ELEVATOR WELL DOOR OPERATOR AND LOCK.—P. G. WESTERBERG, care of St. Luke's Hospital, Amsterdam Ave. and 113th St., New York, N. Y. The present invention relates to an improved device for holding the gate or door of an elevator well or the like positively locked when closed so as to prevent opening thereof except by the operator of the elevator, and also to permit opening and closing of the gate conveniently by the operator.

PAPER MAKING MACHINE.—D. L. LESLIE and J. L. HARRIS, Box 51, Roanoke Rapids, N. C. This invention provides means for measuring or gaging the thickness of a sheet of paper just after it has been formed and when it is still in the wet state before being calendered. It provides a gage which may be



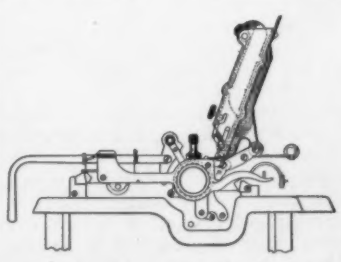
PAPER MAKING MACHINE.

turned so as to be readable from various parts of the room in which the machine is situated. It also provides means for indicating the thickness of the paper at any desired place. A special form of gage is provided which will register variations of 1/10,000 of an inch in the thickness of the paper.

FEATHER FABRIC MACHINE.—J. A. COLEY, Somerville, N. J. In the present patent the invention has reference to machines for manufacturing feather goods, and has particular reference to a machine for assembling suitable feathers in the form of boas, or for general purposes, such as for collars or trimmings.

SMOKE STACK CLEANER.—F. C. WILLAT, Montevideo, Uruguay, S. A. This invention relates to means for cleaning a smoke stack of soot and other adhering matter, and an object is to provide a readily actuated mechanism, by means of which the inside of the stack may be cleansed of the soot, and the top of the stack automatically closed in the act of starting the brushing mechanism.

ATTACHMENT FOR FEEDING CARDS TO TYPE WRITERS.—I. G. HOLLIDAY, Boise, Idaho. Mr. Holliday's invention is an improvement for feeding cards to typewriters, wherein a magazine is provided for containing a packet of cards, envelopes, or like articles, as for instance, filing cards and mechanism in connection with the magazine for feeding the cards in succession to the typewriter. The engraving herewith gives a view of the improved feed shown in connection with the typewriter.

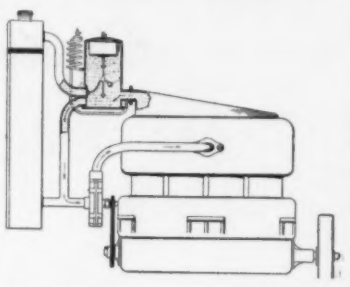


ATTACHMENT FOR FEEDING CARDS TO TYPEWRITERS.

MECHANICAL MOVEMENT.—C. W. GIFT, R. F. D. No. 2, Box 24, Waynesboro, Pa. The invention provides a simple, inexpensive means for converting reciprocating movement into rotary movement. The rotary member consists of a wheel with half of its circumference concentric and the other half having a depression with teeth at each side. It rotates within a frame which constitutes the reciprocating member, the latter having an internal periphery patterned to mesh with the rotary member.

Prime Movers and Their Accessories.

AUTOMATIC RADIATING SYSTEM FOR INTERNAL COMBUSTION ENGINES.—E. A. SAYRE, 52 Grove Ave., Elgin, Ill. An object here is to provide a radiating system in which the heat of the engine may be retained until

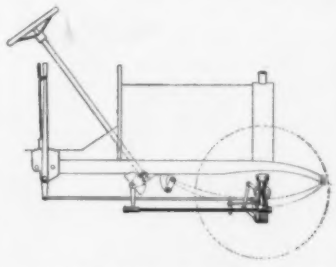


AUTOMATIC RADIATING SYSTEM FOR INTERNAL COMBUSTION ENGINES.

it has reached such a degree as to insure its most efficient working, after which a circulation of water or of other cooling medium is automatically started through the radiator, thereby tending to keep the engine from overheating.

Pertaining to Vehicles.

AUTOMOBILE WHEEL CONTROLLING MEANS.—W. F. MITCHELL and E. E. HENRY, care of the former, 2637 Birch St., Astoria, Ore. This invention relates to carriages and vehicles, and has particular reference to the running gear of such vehicles. Among the ob-



AUTOMOBILE WHEEL CONTROLLING MEANS.

jects of this invention is the provision of controlling means for wheels, such as motor vehicle wheels, whereby said wheels may be tilted while turning a curve, for the purpose of reducing the tendency of skidding and to minimize the danger of straining the wheels and the means of supporting the wheels.

Designs.

DESIGN FOR A MUSTARD BOTTLE.—R. A. LUSK, 238 Front St., New York, N. Y. This design shows a short cylindrical neck merging into a flared shoulder, the outline of which is a compound curve. Below the shoulder is a swell. Under this is a straight body portion, at the lower end of which is another swell in the reverse direction of the first and merging into a small base.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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AGENTS, 500% Profit. Free Sample Gold and Silver Sign Letters for store fronts and office windows. Any one can put on. Big demand everywhere. Write today for liberal offer to agents. Metallic Letter Co., 438 N. Clark St., Chicago, U.S.A.

BIDS WANTED

The Village of Waterloo, Wis., is contemplating installing a Municipal Steam Heating Plant, and would like bids on material used for such a system. For further particulars address Edw. A. Peters, Pres.

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START an original mail-order business. Honest, Independent. Small Capital. New Methods. Sole Rights. Big Money. R. Clement Moore, Business Specialist, New Egypt, N. J.

CORRESPONDENCE INVITED concerning a large Cocoanut Estate with very favorable prospects. Situate on the seashore, Guzerat, India. Full particulars, on request, from Shalebhoy Tyebjee & Sons, Bank Street, Fort Bombay, India.

SIDE LINE SALESMEN, ATTENTION! This year's proposition the best yet. Get in touch with us for premium proposition. We guarantee our goods to sell, or take back unsold goods. Canfield Mfg. Co., 208 Siegel Street Chicago, Ill

UNUSUAL OPPORTUNITY FOR A PARTY LOOKING FOR A FACTORY. A well equipped factory for sale in highly desirable location, the seller agreeing if desired to take the entire output. Best of reasons for selling. Address: R. Box 773, N. Y. City.

INVENTORS: A manufacturer of metal specialties wants a newly patented household novelty. Will buy outright or take on royalty basis. Write, National Indicator Company, Long Island City.

PATENTS FOR SALE

I AM OFFERING for investment my U. S. patent, issued May 19, 1914, for Improved Flying Machine. It is safe and efficient. Comparatively small capital required. Simon B. Voss, Hartly, Delaware.

INQUIRIES

Inquiry No. 9387. Wanted the name and address of manufacturer of composition roofing for tops of freight cars that will stand reasonable wear and tear, and for extreme wet weather and hot tropical climate.

Inquiry No. 9388. Wanted the name and addresses of manufacturers of a fiber board, which is absolutely smooth on both sides, not subject to warping and free from any imperfections such as ridges or small irregularities. Board should come to about 5 ft. wide by 5½ ft. long, and run from ⅛ to ¼ of an inch in thickness, and must be reasonably economical. A board of hard rubber would be exactly what was required, only the expense is too prohibitive to make its use practical.

Russia's Giant War Flyers

(*Concluded from page 135.*)

seconds; and that these flights were made with two 200 horse-power Saimson motors, whereas the motive power formerly employed for the Sikorsky machine took the form of four Argus engines of 100 horse-power each.

A Huge Machine.

The dimensions of the "Ilya Murametz," an advance on anything previously attempted in aeroplanes, measure 121 feet in span, the chord of the planes is 9 feet, the total lifting area 1,950 square feet, and the covered-in fuselage measures 65 feet from nose to tail, and 6 feet in height by 5¼ feet in width at the bow. As will be seen from the illustration, the nose contains a small cabin for two pilots, and behind this is a cabin for passengers. Behind this again a small sleeping apartment, and still further, a very small lavatory; each compartment being lighted by electricity and heated by the exhaust from the engines. The tail consists of a fixed tail plane, a large elevator and a triple rudder with an area of about 55 square feet. The chassis comprises four large disk wheels sprung on elastic shock absorbers, which take the place of the skids which were part of the original design, but were found to develop too much friction.

Sikorsky has succeeded in developing a marvelous weight carrier. It has carried eighteen human beings, and is a very steady machine, without going beyond the ordinary accepted principles of design in aeroplanes, as understood hitherto. His only innovation has been that of large dimensions, and according to the latest information from Russia, which I have received through a most reliable source, he is not even contemplating the construction of a new type of machine.

Whatever the size of his productions may be he intends to still build to the old model. It may be noted that Sikorsky, though a young man, has studied the construction of aeroplanes in other countries than Russia, although he commenced his experiments in aeronautics there, and designed and built machines on his own account before going abroad to gather further experience. Yet he built the "Ilya Murametz" of wood throughout, mainly Russian pine and beech; and he continues to use the well-known integral propellers, the invention of M. Chauvière, which have carried so many flying machines to victory over the elements in recent times, because his experience teaches him that there are none better.

The Problem of Strength and Weight.

In attempting to deal with the greatest of all difficulties met with in the construction of the large machines with continually increasing span which are demanded by the military and naval services of the great powers for long-distance work, and fuel-carrying capacity—the relation of strength to weight—Sikorsky has been most successful.

If, while increasing the span of the machine, the designer allows no more than the same number of bracing points and keeps to the same angles for his bracing wires, he is bound to increase the size and weight of his spars to allow a proper margin of safety. This is not only necessary in order to bear the strains caused by aerodynamic reaction in flight, while the machine is new, but because lightly built machines require constant adjustment owing to the stretching of the bracing wires, and if continuously flown at short intervals soon lose their efficiency. It is, of course, obvious that the heavier spars add to the total weight, but though not quite so obvious, it is nevertheless a fact, that the weight of these spars which may be necessary to carry the same load per square foot of supporting surface will increase out of all proportion to the area and much more rapidly than the load carried by the supporting surfaces.

If it is necessary, therefore, to keep the weight down so as to bear a reasonable and safe proportion to the area, the designer must increase the number of bracing points in the same ratio as he increases the span of the aeroplane. Even this method has its limits, and every addi-

tional wire increases the resistance offered to the air when in flight, and gives more work to the motive power in overcoming it, and the amount of resistance which a vibrating cord or wire opposes to the wind may be gaged from the manner in which vibrating telephone and telegraph wires are broken in a gale, though their surface is so small when at rest.

Twin Landing Chasses Suggested.

It becomes a question whether it would not be more profitable to build large machines with twin landing chasses, braced together and to the wing tips, with a central fuselage, distributing the weight in this fashion more evenly over the supporting surface of the planes. Combined with such a system of construction some method of automatic gyroscopic stabilizing, such as Sperry's, might be used in order to ease the control. It is noteworthy, however, in connection with the question of the load carried by the planes, that Sikorsky has been very successful hitherto in keeping it well within limits, for in the case of the "Ilya Murametz" the loading only amounts to 5 pounds per square foot in spite of the fact that the machine itself weighs 7,500 pounds, and it has a useful load of about 2,240 pounds. As compared with many other machines, and notably those built for racing purposes, this is quite exceptionally small and speaks well for the designer.

Size Apparently Improves Stability.

It has been mentioned that, besides being great weight carriers, the Sikorsky machines have been exceptionally stable. It is not improbable that their very size tends to make them so, because wind gusts, as compared with the volume of a prevailing wind of general uniform direction, are usually of small volume and very local effect. A large aeroplane is less likely, therefore, to be affected by them as regards its whole bearing surface and having more inherent inertia than a small one would be less liable to be overturned. Of course large machines have necessarily the defects of their qualities in this respect, in that the controlling surfaces being correspondingly large, make heavy work for the pilot in working the controls.

They consequently offer a favorable field for the use of modified automatic control by gyroscopic or other apparatus. The ideal stabilizer would be one which would be normally automatic, in order to save the pilot exertion during the greater part of the journey, and while there was plenty of room to maneuver, one which could be thrown out of gear instantly when near the ground in order that he might take complete charge of movements of the machine in a confined space, or under circumstances which required quick turning or elevating movements.

A Weakness of Large Machines.

The large aeroplane is by its very nature slow, more especially if designed to lift great weight, and variation of speeds and heavy loading do not work in together. This is to my mind the weak point of the Sikorsky machines. Speed is essential in a war aeroplane for every reason, though principally in order that it may be able to go up in spite of high wind, and incidentally for scouting purposes or to out-pace the enemy's aircraft. Variable speed is desirable for a heavy machine in order to effect safe landings. One can image a Sikorsky machine doing admirable work in patrolling a frontier, heavily armed, and capable of keeping on duty for long periods, in order to ward off an enemy's scouts, whether dirigibles or aeroplanes, but for scouting or fighting against adverse winds a maximum speed of 60 to 70 miles at least should be available. This so far has not been achieved, and practical experience can alone show whether it can be achieved with such large and heavy machines without sacrificing stability. Such experience with smaller machines in Great Britain has shown that while flying perfectly and showing admirable stability with engine power suited to their size, they behave quite otherwise when the engine power is increased, and require constant attention from the pilot at the controls.

A Solution of the Speed Problem.

A solution of the question of requisite speed may perhaps be found in the reduction of the weight for horse-power of the engines, and apparently Sikorsky hopes to find it by this means. The four Argus engines originally used by him for the "Ilya Murametz" weighed 480 pounds each, but it would be possible to get much lighter ones, either stationary or rotary. The former type would probably serve the purpose better in this case, because more suitable to journeys of long duration in that it is economical of fuel. The lesser amount of fuel which need be carried will more than make up for the greater actual weight of engine. Incidentally economy of fuel will also in time reduce the prime cost of engine, a consideration which is worth bearing in mind when numbers of engines have to be purchased for the numerous aircraft which the great powers will find necessary for the equipment of their armies and navies.

How Many Motors?

The question of multiplicity of engines in one craft is now being studied by all builders and designers of large aeroplanes, as witness the large sea-planes which are being built for the British and German governments, the Bossi and Curtiss airboats intended for transatlantic flight, and Sikorsky is no exception to the rule. The tendency at present is rather toward installing two engines of equal power, each of which alone is capable of propelling the machine, rather than to have say four smaller ones with an equal total horse-power. Time alone can show which is the better system, but it will have one inevitable result—the subdivision of labor, since the work of pilot, navigator, and mechanic in an aeroplane, so equipped, cannot be performed by one man.

The Current Supplement

THE opening article in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2016, deals with the timely topic of the submarine and the dreadnought, and discusses the nature of the contest between these two types in naval warfare. The submarine is in reality as yet an unknown factor, and its possibilities in attack and methods of successful defense against it are yet to be learned. It is expected that much will be learned on these points in the impending European naval battles.—The protection of battleships against submarine attacks will be of interest in this connection, as it deals with the possibilities of providing armor for ships' bottoms, and raises an entirely new question.—Coal and its by-products is an unusually pleasing story, telling how coal originated, its composition and the products that are derived from it. The first installment appears in the current issue.—The evolution of coins and coinage mechanism is of value historically, and illustrates a very large number of early specimens.—The determination of plant relationship by means of serum describes a new means for the historical investigation of the origins and relationships of plants.—The meeting of the British Association in Australia is noted, with a list of the papers to be read.—Another installment of the invaluable paper on flying machines is an article that should not be missed.

A Society that Studies Instruments of Precision

THE Chronometric Society is one which has just been founded at Paris, and its first meeting took place toward the latter part of May. This association is open to all persons who are interested in the progress of chronometry and high precision mechanism, and its programme comprises all questions in this class of science or industry, viewed from scientific, technical, or historic standpoint. Its president is the well-known Prof. Lippmann, and among vice-presidents are M. Ch. Ed. Guillaume, a leading authority on metric standards, and M. P. Puiseux, the well-known astronomer.

Two Tons of Cascara Bark have just been sold from the Siuslaw national forest, Oregon, at one cent a pound.

WAR NUMBER

OF THE

SCIENTIFIC AMERICAN

ISSUED SEPTEMBER 5th

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With a view to answering the thousand-and-one questions which the public is asking about the titanic conflict which is convulsing the whole of Europe on sea and land, there will be published, on Sept. 5th, a special issue of the Scientific American of triple the size of the regular weekly edition.
The issue will be arranged in two sections dealing respectively with the armies and the navies of the Triple Alliance and the Triple Entente.

ARMY SECTION

The Army Section will include chapters on:

The comparative strength of the Armies engaged, illustrated by diagrams and compiled from the latest military statistics.

The Armament, with tables showing for each power the shoulder pieces, machine guns, field guns, howitzers and siege guns, with full details of caliber, weight, velocity, range, danger zone, etc., and a description of the action of shrapnel and shell and the decisive part played in attack and defense by modern artillery.

How an army is fed during a great battle, describing the wonderful organization by which, from a central depot, miles to the rear, the rations are fed out on diverging lines, until each man on a fighting line fifty to one hundred miles in length, is supplied with food and other necessities for his sustenance and wellbeing.

The Signal and Telegraph Service. This chapter will describe the wonderful organization of telegraphs, telephones, flag and flashlight signals by which the Commander-in-Chief, at a base, many miles to the rear, is kept in close touch with the various army Corps, divisions, etc., and has his hand and eye upon a battle-front that may extend, as in the battle of Mukden, for over 100 miles.

The Medical and Ambulance Service. Only less important than fighting the battle is the speedy relief of the wounded and their quick removal to the rear as the battle progresses. This chapter will explain the highly efficient organization of the medical service in modern warfare.

Every chapter will be elaborately illustrated with photographs showing the latest rifles, guns, transport, medical equipment, etc., of modern armies.

NAVY SECTION

The Navy Section will include chapters on:

The comparative size and strength of the Navies, both of the Triple Entente and the Triple Alliance. The Scientific American has gathered these data from the most reliable sources, and they are absolutely correct up to August 15th, 1914. The tables will be illustrated by diagrams. One of these will show the relative strength in all ships combined—the other the rating in dreadnoughts.

The Contending Navies in Detail. A chapter on each of the Navies engaged in this War. Each chapter will include a photograph of one or more battleships, armored cruisers, scouts, destroyers and submarines, of each fleet, with a description of the special characteristics of each. Each photograph will represent one ship of a large class, so that any ship mentioned during the War will be represented in this issue. These views have been selected from a file of about 1000 typical ships of the World's Navies.

Tables of Naval guns showing the caliber, weight, velocity, striking energy, etc., of all the types mounted in the navies discussed.

The strategy of the Naval War, showing by the aid of a map, the enormous advantage to Germany of the Kiel Canal and the coast defense works, upon which she has spent such great sums in the past two decades.

AEROPLANES AND DIRIGIBLES

War in the Air. For the first time war will be carried into the air. For scouting, and to a limited extent for attack by bomb-dropping, the dirigible and the aeroplane will play a most important part. The number will contain a highly illustrated article covering this phase of the War.

WAR MAP

The number will contain a map drawn especially for the use of those who by colored pins may wish, day by day, to trace the progress of the rival fleets and armies.

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